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**Trends in Motorcycle Crashes  
in Michigan: 1997-2002**

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16. Abstract  Michigan crash data from 1997 to 2002 were analyzed for trends and patterns in motorcycle crashes. Over the 6-year period, the number of motorcycles registered in Michigan increased by 45%; licensed motorcyclists increased by 8%; and motorcycle crashes increased by 20%. The largest increases in licensed motorcyclists were among those age 45-64. In 2002, there were 15.4 crashes per 1,000 registered motorcycles, a 18% decrease from 1997; and 5.9 crashes per 1,000 licensed motorcyclists, a 12% increase from 1997. The highest crash rate was among motorcyclists below age 19, and the lowest was among those over age 64. About 44% of crash-involved motorcyclists were not legally licensed to operate a motorcycle. The proportion of unlicensed motorcyclists among crash-involved motorcyclists varied by age, with the largest proportion among those below age 19. Between 1997 and 2002, the number of motorcycle crashes in which a driver had been drinking (HBD) decreased 4%, the number of fatalities from HBD crashes decreased 20%, and the proportion of HBD-crash fatalities among all crash fatalities decreased from 47% to 29%. The number of crashes involving motorcyclists, age 45-64 who had been drinking increased by 71%. Helmet use among crash-involved motorcyclists increased from 94% in 1997 to 97% in 2002. The high proportion of unlicensed motorcyclists was identified as a problem that should be addressed by public information and special enforcement programs.					
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## 1. INTRODUCTION

The likelihood of death or injury in a motorcycle crash is much higher than in other vehicle crashes. According to the National Highway Traffic Administration (NHTSA) (2003a), 80% of motorcycle crashes result in a death or injury, while in passenger vehicle crashes this proportion is 20%. The number of motorcycles in the U.S. has increased significantly in the past few years, and the number of U.S. deaths from motorcycle crashes increased by 53% from 2,116 deaths in 1997 to 3,244 deaths in 2002 (NHTSA, 2003b). In 2002, motorcycles represented 2.2% of all registered vehicles in the United States (U.S.), but crashes involving motorcycles accounted for 7.6% of total traffic fatalities on U.S. roads. The increase in deaths resulting from motorcycle crashes, and expectations that the number of motorcycles will continue to increase (Motorcycle Industry Council, 2001) have raised concerns in the traffic safety community. As part of the traffic safety community, the Michigan Office of Highway Safety Planning (OHSP) asked for an analysis and assessment of recent trends in motorcycle crashes in Michigan. Such an assessment is a necessary first step in identifying opportunities and programs for reducing motorcycle crash-related deaths and injuries in the state.

This report examines trends in Michigan motorcycle crashes from 1997 through 2002. Data and methods of analysis are described in the next section. Trends in the number and severity of motorcycle crashes; crash rates; licensing; and the time, location, and environmental conditions of crashes are reported in the third section. Single vehicle and multi-vehicle motorcycle crashes are examined in the fourth section. Crashes in which the motorcyclist had been drinking alcohol are examined in the fifth section, and helmet use is reported in the sixth section. A summary of notable trends and suggestions for improving motorcycle safety are in the last section of the report.

## 2. DATA AND METHODS

Michigan vehicle crash data from 1997 through 2002 (UMTRI, Transportation Data Center, 1998, 1999, 2000, 2001, 2002, and 2003) are used for most of the analyses reported. These data cover all police-reported motor vehicle crashes in Michigan for the 6-year period (1997-2002), and come from information coded on police crash reports (UD-10 forms). Rates for crash occurrence were based on numbers of registered motorcycles and licensed motorcyclists. Data on motorcycle registrations and motorcycle licenses were obtained from the Michigan Department of State. Crashes in which one of the involved drivers was flagged for alcohol use are referred to as *had been drinking* (HBD) crashes.

Most analyses in this study examine change in distributions of key variables from the Michigan vehicle crash data files. The data files for each year contain three linked files: the crash file with descriptive information about the crash itself; the vehicle/driver file with information on the vehicle and the driver; and the person file with information on the occupants of the vehicles involved in the crash. Choices about which files to use when similar information was contained in more than one file were based on the amount of missing data for the variable in each file.

The Fatality Analysis Reporting System (FARS) (NHTSA, 2003c) data are a census of all fatal vehicle crashes in the United States, and include additional information not found in the Michigan crash data files. FARS data are used in this report to examine blood alcohol concentration (BAC) levels of motorcyclists involved in fatal crashes. Because FARS data for 2002 were not available at the time this report was prepared, BAC analyses are limited to the years 1997 through 2001.

### 3. ALL MOTORCYCLE CRASHES

#### Number and Severity

Table 1 shows the overall number of all police-reported crashes in Michigan, and the number and percentage of crashes involving motorcycles from 1997 through 2002. During those 6 years, there was a 7% decrease in the number of all police reported crashes, and a 20% increase in the number of crashes involving motorcycles. Even though the number and proportion of motorcycle crashes increased from 1997, motorcycle crashes accounted for less than 1% of all vehicle crashes in Michigan in 2002.

Table 1. Number and Proportion of Vehicle Crashes Involving Motorcycles, 1997-2002			
Year	All Crashes	Crashes Involving Motorcycles	
		Number	Percent of All
1997	425,793	2,543	0.60
1998	403,766	2,997	0.74
1999	415,675	2,914	0.70
2000	424,852	3,184	0.75
2001	400,813	3,216	0.80
2002	395,515	3,051	0.76
% Change 1997-2002	-7.11%	19.98%	0.16

Table 2 shows the number and percentage of motorcycle crashes for fatal, non-fatal injury, and property-damage-only (i.e., no injury) severity levels. The proportion of fatal crashes among motorcycle crashes in 2002 was almost the same as in 1997 at 2.5-2.6%. The proportion of injury crashes also remained relatively constant. Together, the fatal and injury crashes accounted for 77-78% of all motorcycle crashes. In contrast, the proportion of fatal and injury crashes among all vehicle crashes in Michigan over the same 6 years was 20-23% (Kostyniuk and Miller, 2003).

Table 2. Motorcycle Crashes by Severity, 1997-2002				
	Fatal	Non-fatal Injury	Property- damage-only	Total
1997	63 (2.5%)	1,908 (75.3%)	572 (22.5%)	2,543 (100%)
1998	49 (1.6%)	2,266 (75.6%)	682 (22.8%)	2,997 (100%)
1999	77 (2.6%)	2,190 (75.2%)	643 (22.1%)	2,914 (100%)
2000	76 (2.4%)	2,365 (74.3%)	743 (23.3%)	3,184 (100%)
2001	91 (2.8%)	2,399 (74.6%)	726 (22.6%)	3,216 (100%)
2002	80 (2.6%)	2,262 (74.1%)	709 (23.2%)	3,051 (100%)

Table 3. Motorcycle Crashes as Proportion of All Vehicle Crashes by Severity, 1997-2002				
		Fatal	Non-fatal Injury	Property-damage-only
1997	All Crashes	1,283	95,359	329,151
	Motorcycle Crashes (% of all)	63 (4.9%)	1,908 (2.0%)	572 (1.7%)
1998	All Crashes	1,235	91,137	311,394
	Motorcycle Crashes (% of all)	49 (4.0%)	2,266 (2.5%)	682 (2.2%)
1999	All Crashes	1,249	87,820	326,606
	Motorcycle Crashes (% of all)	77 (6.2%)	2190 (2.5%)	643 (2.0%)
2000	All Crashes	1,237	87,043	336,472
	Motorcycle Crashes (% of all)	76 (6.1%)	2,365 (2.7%)	726 (2.2%)
2001	All Crashes	1,206	80,922	318,685
	Motorcycle Crashes (% of all)	91 (7.6%)	2,399 (3.0%)	726 (2.3%)
2002	All Crashes	1,175	80,567	313,773
	Motorcycle Crashes (% of all)	80 (6.8%)	2,262 (2.8%)	709 (2.3%)
% Change 1997-2002	All Crashes	-8.4%	-15.5%	-4.7%
	Motorcycle Crashes	27.0%	18.6%	24.0%

Table 3 shows the severity distribution of all vehicle crashes and the proportion of motorcycle crashes at each severity level. Motorcycles were involved in 4-8% of the fatal vehicle crashes in each of the 6 years from 1997 through 2002. During that time, the number of fatal motorcycle crashes increased by 27%, and the proportion of motorcycle crashes among all fatal crashes increased from 4.9% to 6.8%. In contrast, the total number of all fatal vehicle crashes in Michigan decreased by 8% over the same time period. Between 1997 and 2002, the number of all non-fatal injury crashes in Michigan decreased by 16%, but the number of motorcycle crashes that resulted in a non-fatal injury increased by 19%. The number of all property-damage-only crashes decreased by 5% overall, but increased by 24% for motorcycles.

The number of people killed and injured in all motor vehicle crashes from 1997 through 2002, and the proportion among them killed and injured in motorcycle crashes are shown in Table 4.

Table 4. People Killed and Injured in All Vehicle Crashes and Motorcycle Crashes, 1997-2002								
		1997	1998	1999	2000	2001	2002	% change 1997-2002
Number of Persons Killed	All crashes	1,446	1,367	1,386	1,382	1,328	1,279	-11.6%
	Motorcycle Crashes (% of all)	64 (4.4%)	54 (4.0%)	79 (5.7%)	80 (5.8%)	94 (7.1%)	82 (6.4%)	28.1% -
Number of Persons Injured	All Crashes	137,548	131,578	124,601	121,826	112,294	112,484	-18.2%
	Motorcycle Crashes (% of all)	2,238 (1.6%)	2,611 (2.0%)	2,540 (2.0%)	2,707 (2.2%)	2,767 (2.5%)	2,607 (2.3%)	16.5% -

In the 6-year period, the number of people killed in all motor vehicle crashes decreased by almost 12%, while the number of people killed in motorcycle crashes increased by 28%. The proportion of fatalities from motorcycle crashes relative to fatalities from all vehicle crashes increased from 4% to 6% over the 6-year period. While the number of people injured in all vehicle crashes in Michigan decreased by about 18%, the number of people injured in motorcycle crashes increased by 17%.

## Registrations, Licenses, and Crash Rates

Table 5 shows the number of motorcycles registered in Michigan from 1997 through 2002, and the crash rate per 1,000 registered motorcycles for each year.

Table 5. Registered Motorcycles and Crash Rate per 1,000 Motorcycles, 1997-2002			
	Motorcycle Registrations	Number of Crashes	Crashes per 1,000 Registered Motorcycles
1997	136,030	2,543	18.7
1998	147,056	2,997	20.4
1999	160,752	2,914	18.1
2000	176,334	3,184	18.1
2001	191,888	3,216	16.8
2002	197,735	3,051	15.4
% Change 1997-2002	45.4%	20.0%	-17.4%

Between 1997 and 2002, the number of motorcycles registered in Michigan increased by 45%, and their proportion of the state's registered vehicles increased from 1.5% to 2.0% (Michigan Department of State, 2002). Although the number of crashes increased by 20%, the even larger increase in the number of registered motorcycles contributed to an overall decrease in the vehicle crash rate. In 1997, the crash rate was about 19 crashes per 1,000 registered motorcycles, and in 2002, the crash rate was 15 crashes per 1,000 motorcycles, a decrease of approximately 17%.

A person must be at least 16 years of age, and have a motorcycle endorsement on a valid driver's license to legally operate a motorcycle in Michigan (Michigan Vehicle Code 257.312a). Drivers satisfying these conditions are referred to as licensed motorcyclists in this report (See Appendix A). Table 6 shows the number of licensed motorcyclists, the number of crashes, and the crash rate per 1,000 licensed motorcyclists in Michigan for each year from 1997 through 2002.

Table 6. Licensed Motorcycle Drivers and Crash Rate per 1,000 Motorcycle Drivers, 1997-2002			
	Licensed Motorcyclists	Number of Crashes	Crashes per 1,000 Licensed Motorcyclists
1997	433,405	2,543	5.9
1998	438,805	2,997	6.8
1999	442,492	2,914	6.6
2000	448,693	3,184	7.1
2001	457,001	3,216	7.0
2002	465,786	3,051	6.6
% Change 1997-2002	7.5%	20.0%	11.9%

In the 6 years between 1997 and 2002, the number of licensed motorcyclists increased by 7.5%, and the crash rate per 1,000 licensed motorcyclists increased by almost 12%

The changes in the number of crashes, licensed motorcyclists, and crash rates were further examined by age. Table 7 shows the number of crashes, the number of licensed motorcyclists, and the crash rate per 1,000 licensed motorcyclists by age category for each year. The table reveals several interesting patterns and trends. The first trend is the aging of the population of licensed motorcyclists in Michigan. In 1997 and 1998, the largest number of licensed motorcyclists was in the 30-44 age group. From 1999 through 2002, however, the largest number of licensed motorcyclists was among those age 45-64. The largest growth rate in the number of licensed motorcyclists was among those over age 64, and the second largest growth rate was among those age 45-64. In 1997, the proportion of all licensed motorcyclists over age 44 was 45%. In 2002, this proportion was 59%. During that time, the number of licensed motorcyclists below age 45 decreased by 20%.

Except for 1997, motorcyclists age 30-44 were involved in more crashes than motorcyclists in any other age group, and motorcyclists over 64 years were consistently involved in the fewest crashes (Table 7). Although the number of crashes involving the

oldest motorcyclists was still quite small in 2002, it had increased by 60% from 1997. However, the largest increase in the number of crashes (87%) was among motorcyclists age 45-64.

Table 7. Motorcycle Crashes, Licensed Motorcyclists, and Crash Rate by Age, 1997-2002								
Age		1997	1998	1999	2000	2001	2002	% change 1997-2002
≤ 18	Crashes	304	353	320	352	325	345	13.5%
	Licensed Motorcyclists	929	813	731	734	761	764	-17.8%
	Crashes/1,000 Lic. Motorcyclists	327.2	434.2	437.8	479.6	427.1	451.6	38.0%
19-29	Crashes	873	947	870	966	912	750	-14.1%
	Licensed Motorcyclists	35,741	34,884	32,769	31,800	31,513	31,179	-12.8%
	Crashes/1,000 Lic. Motorcyclists	24.4	27.1	26.5	30.4	28.9	24.0	0.2%
30-44	Crashes	782	990	908	1,041	1,039	937	19.8%
	Licensed Motorcyclists	204,039	195,508	185,270	176,507	168,826	160,813	-21.2%
	Crashes/1,000 Lic. Motorcyclists	3.8	5.1	4.9	5.9	6.2	5.8	52.6%
45-64	Crashes	486	596	668	736	801	907	86.6%
	Licensed Motorcyclists	174,229	187,639	202,066	216,130	230,362	244,835	40.5%
	Crashes/1,000 Lic. Motorcyclists	2.8	3.2	3.3	3.4	3.5	3.7	32.1%
65+	Crashes	30	31	30	41	54	48	60.0%
	Licensed Motorcyclists	18,467	19,963	21,656	23,522	25,539	28,195	52.7%
	Crashes/1,000 Lic. Motorcyclists	1.6	1.6	1.4	1.7	2.1	1.7	6.3%

For each year from 1997 through 2002, the crash rate per licensed motorcyclist decreased with age (Table 7). Motorcyclists younger than 19 years consistently had the highest crash rates. Although the actual number of crashes was small, the number of licensed motorcyclists in the youngest age group was also very small, yielding a high crash rate per licensed motorcyclist. Within each age group, except age 19-29 (which varies), the

crash rates increased from 1997 through 2002. The largest increase in crash rate was among motorcyclists age 30-44 which increased by 52% from 3.8 to 5.8 crashes per 1,000 licensed motorcyclists. Notable also was the 32% increase in crash rate for motorcyclists age 45-64, from 2.8 to 3.7 crashes per 1,000 licensed motorcyclists. The crash rate for motorcyclists age 19-29 was the about same in 2002 as it was in 1997.

Table 8 shows the number of licensed motorcyclists and the crash rate per 1,000 licensed motorcyclists by sex for each year from 1997 through 2002. Some interesting patterns and trends are revealed. Most motorcycle crashes involved male motorcyclists. The proportion of crashes involving female motorcyclists was 5-7% each year between 1997 through 2002, and the proportion of women among licensed motorcyclists remained relatively constant at 8-9% over the 6-year period. Although the number of both male and female licensed motorcyclists increased from 1997 through 2002, the growth rate for women was much higher than that for men (19% compared to 7%) The crash rate for men was greater than for women, but the increase in crash rate was greater for women than for men (20% for women and 10% for men).

Table 8. Motorcycle Crashes, Licensed Motorcyclists, and Crash Rate by Sex, 1997-2002						
	Male			Female		
	Motorcycle Crashes	Licensed Motorcyclists	Crashes per 1000 Licensed Motorcyclists	Motorcycle Crashes	Licensed Motorcyclists	Crashes per 1000 Licensed Motorcyclists
1997	2,343	399,172	5.9	141	34,233	4.1
1998	2,793	403,298	6.9	148	35,007	4.2
1999	2,687	406,509	6.6	157	35,983	4.4
2000	2,963	411,585	7.2	170	37,108	4.6
2001	2,997	418,334	7.2	165	38,667	4.3
2002	2,780	424,924	6.5	202	40,862	4.9
% change 1997-2002	18.7%	6.5%	10.2%	43.3%	19.4%	19.5%

## Unlicensed Motorcyclists

To determine if crash rates per 1,000 licensed motorcyclists were an accurate measure of crash involvement from 1997 through 2002, motorcycle crash records were examined by the motorcycle license status of crash-involved motorcyclists. Table 9 shows the number and proportion of all crash-involved motorcyclists with a valid motorcycle endorsement (i.e., licensed motorcyclists) by age for each year from 1997 through 2002.

Table 9. Number and Proportion of Crash-Involved Motorcycle Drivers with a Valid Motorcycle Endorsement by Age, 1997-2002						
	≤18	19-29	30-44	45-64	65+	Total*
1997	45 (14.8%)	409 (46.9%)	502 (64.2%)	383 (78.8%)	22 (73.3%)	1,427 (55.2%)
1998	67 (19.0%)	435 (45.9%)	647 (65.4%)	596 (77.7%)	25 (80.7%)	1,728 (56.5%)
1999	47 (14.7%)	406 (46.7%)	555 (61.1%)	522 (78.1%)	26 (86.7%)	1,649 (55.9%)
2000	71 (20.2%)	419 (43.4%)	644 (61.9%)	558 (75.8%)	25 (61.0%)	1,809 (55.2%)
2001	75 (23.1%)	433 (47.5%)	618 (59.5%)	563 (70.3%)	40 (74.1%)	1,815 (55.1%)
2002	79 (22.9%)	352 (46.9%)	564 (60.2%)	637 (70.2%)	38 (79.2%)	1,747 (56.0%)

\* Because of missing data on age, total does not necessarily equal the sum of age groups

Overall, only 55-57% of crash-involved motorcyclists had valid motorcycle endorsements on their drivers' licenses. The possibility that this might be an artifact of data or coding problems was investigated by querying the people responsible for the integrity of the Michigan crash data at the Michigan State Police. They reported no unusual problems with the coding of this variable in police accident reports or in the final Michigan crash data files. Therefore, it was inferred that from 1997 through 2002, 43-45% of crash-involved motorcyclists were not legally licensed to operate a motorcycle.

Examining the motorcycle license status by age shows that motorcycle endorsements were lowest in the youngest crash-involved age group and increased with age. Table 9 also shows changes in the proportion of crash-involved motorcyclists with valid motorcycle licenses from 1997 through 2002. The licensed proportion among the

youngest crash-involved motorcyclists increased from 15% in 1997 to 23% in 2002. The proportion of crash-involved motorcyclists with valid licenses among those age 19-29 was 47% in both 1997 and 2002. In age group 30-44, the proportion of licensed motorcyclists among crash-involved motorcyclists decreased from 64% to 60%, and the proportion of licensed motorcyclists age 45-64 decreased from 79% to 70%. The number of crash-involved motorcycle drivers age 65 and older was quite small, but the proportion with valid licenses in this group varied from 61-87% from 1997 through 2002.

Further examination of the licensing status of crash-involved motorcyclists (Table 10) revealed that each year from 1997 through 2002 about 10-12% did not have a driver's license of any type. The pattern by age indicates that majority of crash-involved motorcyclists without any type of drivers' license were age 18 years and younger. The proportion of crash-involved motorcyclists in this age group without any type of drivers' license was 69% in 1997, and decreased to 54% in 2002.

Table 10. Number and Proportion of Crash-Involved Motorcycle Drivers without Any Driver License by Age Group, 1997-2002						
	≤18	19-29	30-44	45-64	65+	Total
1997	211 (69.4%)	42 (4.8%)	34 (4.3%)	15 (3.1%)	2 (6.7%)	304 (12.0%)
1998	216 (61.2%)	46 (4.9%)	33 (3.3%)	20 (3.4%)	2 (6.5%)	320 (10.7%)
1999	214 (66.9%)	51 (5.9%)	49 (5.4%)	16 (2.4%)	0 (0.0%)	343 (11.8%)
2000	214 (60.8%)	46 (4.8%)	40 (3.8%)	16 (2.2%)	3 (7.3%)	321 (10.1%)
2001	197 (60.6%)	49 (5.4%)	37 (3.6%)	22 (2.7%)	0 (0.0%)	309 (9.6%)
2002	187 (54.2%)	27 (3.6%)	45 (4.8%)	23 (2.5%)	1 (2.1%)	290 (9.5%)

Examining the license status of crash-involved motorcycle drivers by sex (Table 11), shows that the proportion of crash-involved male motorcyclists with a valid motorcycle endorsement remained relatively constant at 57-58% over the 6-years from 1997 through 2002. The proportion of female motorcyclists with a valid motorcycle license was consistently lower than that of male motorcyclists, but increased from 43% in 1997 to 55% in 2002. The proportion of crash-involved female motorcyclists not licensed to drive any type of vehicle (Table 12) decreased from 25% in 1997 to 10% in 2002. The proportion of crash-involved male motorcyclists without any type of driver's license ranged between 7% and 9% over this 6-year period.

Table 11. Number and Proportion of Crash-Involved Motorcycle Drivers with a Valid Motorcycle Endorsement by Sex, 1997-2002		
	Male	Female
1997	1,342 (57.3%)	60 (42.6%)
1998	1,624 (58.2%)	76 (51.4%)
1999	1,537 (57.2%)	86 (54.8%)
2000	1,689 (57.0%)	85 (50.0%)
2001	1,694 (56.5%)	86 (52.1%)
2002	1,614 (58.1%)	112 (55.4%)

Table 12. Number and Proportion of Crash-Involved Motorcycle Drivers without Any Driver License by Sex, 1997-2002		
	Male	Female
1997	208 ( 8.9%)	35 (24.8%)
1998	217 (7.8%)	28 ( 18.9%)
1999	249 ( 9.3%)	25 ( 15.9%)
2000	203 ( 6.9%)	26 ( 15.3%)
2001	205 ( 6.8%)	24 ( 14.5%)
2002	209 ( 7.5%)	20 ( 9.9%)

### Time, Location, and Environmental Conditions

The trends and patterns in the time, location, and environmental conditions of motorcycle crashes are next examined. Table 13 and Figure 1 show the number and distribution of motorcycle crashes by month for each year from 1997 through 2002. The pattern of crash occurrence did not vary over the six years. June, July, and August tended

Table 13. Motorcycle Crashes by Month, 1997-2002												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1997	9 (0.4)	9 (0.4)	59 (2.3)	188 (7.4)	299 (11.8)	525 (20.6)	508 (20.0)	387 (15.2)	312 (12.3)	202 (7.9)	38 (1.5)	7 (0.3)
1998	9 (0.3)	47 (1.6)	84 (2.8)	210 (7.0)	477 (15.9)	432 (14.4)	529 (17.7)	472 (15.8)	405 (13.5)	226 (7.5)	78 (2.6)	28 (0.9)
1999	9 (0.3)	21 (0.7)	78 (2.7)	236 (8.1)	424 (14.6)	476 (16.3)	511 (17.5)	422 (14.5)	390 (13.4)	233 (8.0)	96 (3.3)	18 (0.6)
2000	10 (0.3)	30 (0.9)	174 (5.5)	227 (7.1)	389 (12.2)	546 (17.2)	537 (16.9)	570 (17.9)	336 (10.6)	292 (9.2)	64 (2.0)	9 (0.3)
2001	3 (0.1)	8 (0.3)	90 (2.8)	289 (9.0)	388 (12.1)	551 (17.1)	570 (17.7)	560 (17.4)	386 (12.0)	193 (6.0)	135 (4.2)	43 (1.3)
2002	36 (1.2)	19 (0.6)	57 (1.9)	237 (7.8)	374 (12.3)	514 (16.9)	571 (18.7)	542 (17.8)	443 (14.5)	183 (6.0)	66 (2.2)	9 (0.3)

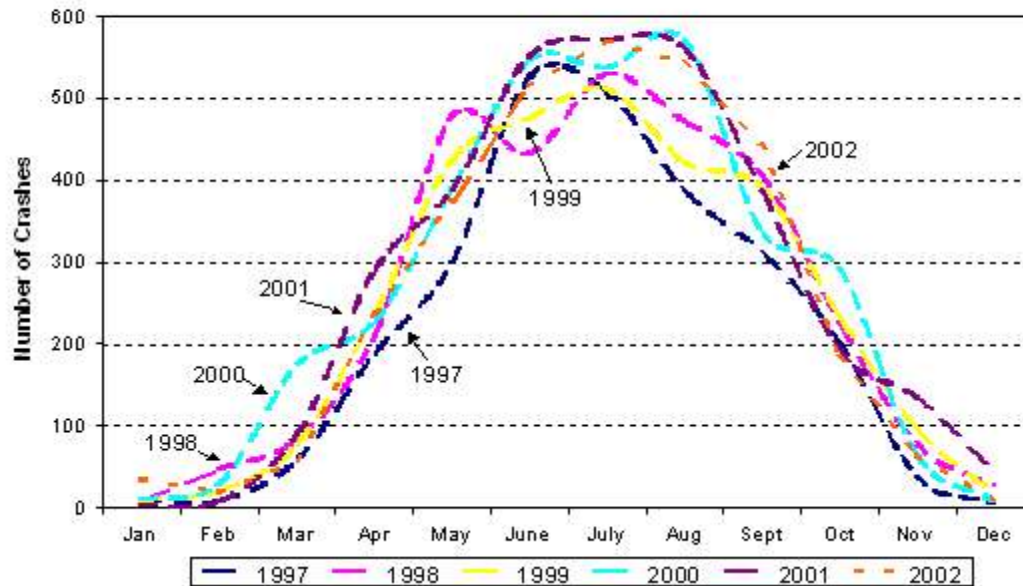


Figure 1. Motorcycle Crashes by Month, 1997-2002

to be the peak months of crash occurrence, followed by May or September. This is not unusual because these are the peak months for recreational travel in the state.

Table 14 and Figure 2 show the number and distribution of motorcycle crashes by day of week.

Table 14. Motorcycle Crashes by Day of Week, 1997-2002							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1997	445 (17.5%)	280 (11.0%)	324 (12.7%)	313 (12.3%)	320 (12.6%)	379 (14.9%)	482 (19.0%)
1998	510 (17.0%)	353 (11.8%)	316 (10.5%)	349 (11.6%)	386 (12.9%)	494 (16.5%)	589 (19.7%)
1999	512 (17.6%)	300 (10.3%)	338 (11.6%)	334 (11.5%)	317 (10.9%)	480 (16.5%)	633 (21.7%)
2000	503 (15.8%)	315 (9.9%)	359 (11.3%)	404 (12.7%)	410 (12.9%)	551 (17.3%)	642 (20.2%)
2001	546 (17.0%)	348 (10.8%)	386 (12.0%)	435 (13.5%)	403 (12.5%)	489 (15.2%)	609 (18.9%)
2002	487 (16.0%)	323 (10.6%)	393 (12.9%)	388 (12.7%)	381 (12.5%)	466 (15.3%)	613 (20.1%)

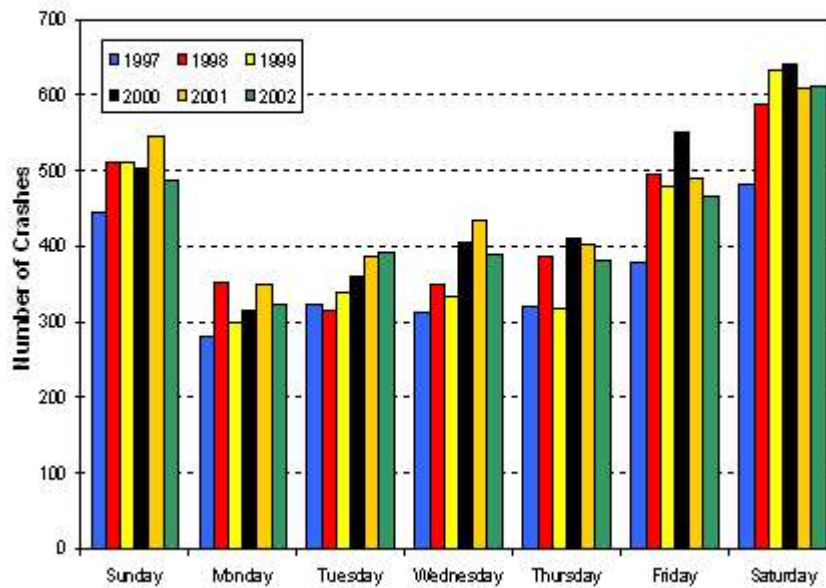


Figure 2. Motorcycle Crashes by Day of Week, 1997-2002

Saturdays remain peak days for motorcycle crashes with 19-22% of all motorcycle crashes. The day of week with the second highest number of crashes was usually Sunday, with about 16-18% of crashes.

Table 15 and Figure 3 show the number and distribution of motorcycle crashes by the time of day for each year.

Table 15. Motorcycle Crashes by Time of Day, 1997-2002								
	12:01 am to 3:00 am	3:01 am to 6:00 am	6:01 am to 9:00 am	9:01 am to 12 pm	12:01 pm to 3:00 pm	3:01 pm to 6:00 pm	6:01 pm to 9:00 pm	9:01 pm to 12:00 am
1997	197 (7.8%)	70 (2.8%)	155 (6.1%)	183 (7.2%)	404 (16.0%)	615 (24.3%)	551 (21.8%)	355 (14.0%)
1998	201 (6.8%)	97 (3.3%)	168 (5.7%)	236 (8.0%)	499 (16.8%)	709 (23.9%)	619 (20.9%)	439 (14.8%)
1999	205 (7.1%)	76 (2.6%)	128 (4.4%)	207 (7.2%)	472 (16.3%)	762 (26.3%)	643 (22.2%)	401 (13.9%)
2000	216 (6.9%)	80 (2.6%)	153 (4.9%)	221 (7.1%)	554 (17.7%)	795 (25.5%)	691 (22.1%)	413 (13.2%)
2001	185 (6.2%)	85 (2.8%)	151 (5.0%)	211 (7.0%)	521 (17.3%)	759 (25.2%)	676 (22.5%)	421 (14.0%)
2002	175 (6.1%)	65 (2.3%)	136 (4.7%)	240 (8.4%)	501 (17.4%)	750 (26.1%)	633 (22.0%)	374 (13.0%)

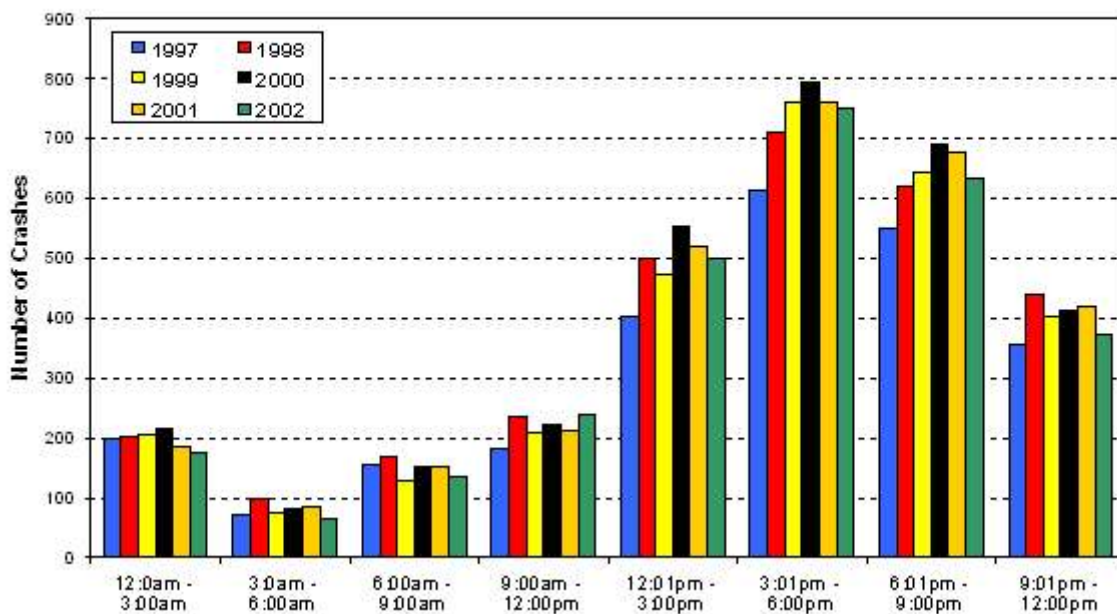


Figure 3. Motorcycle Crashes by Time of Day, 1997-2002

The pattern of motorcycle crashes by time of day has not changed significantly from 1997 through 2002. Approximately one-quarter of motorcycle crashes (24-26%) occurred

from 3:00 P.M. to 6:00 P.M., and close to one-half (45-49%) occurred between 3:00 P.M. and 9:00 P.M.

The location of crashes by traffic control was examined to identify the pattern of motorcycle crash location by intersection or road segment. Signals, stop signs, and yield signs indicate intersections, and no traffic control usually indicates a location away from an intersection or a road segment. Table 16 shows the location of motorcycle crashes by traffic control for each year from 1997 through 2002.

Table 16. Motorcycle Crashes by Traffic Control, 1997-2002				
	Signal	Stop Sign	Yield Sign	None
1997	321 (13.7%)	323 (13.8%)	22 (0.9%)	1,681 (71.6%)
1998	417 (15.0%)	339 (12.2%)	21 (0.8%)	2,005 (72.1%)
1999	423 (15.6%)	350 (12.9%)	30 (1.1%)	1,907 (70.4%)
2000	448 (15.0%)	415 (13.9%)	18 (0.6%)	2,097 (70.4%)
2001	476 (15.7%)	365 (12.0%)	26 (0.9%)	2,166 (71.4%)
2002	393 (13.7%)	381 (13.3%)	37 (1.3%)	2,064 (71.8%)

About 70-72% of motorcycle crashes occurred away from controlled intersections, and about 28-30% occurred at controlled intersections. This pattern has not changed over the 6-year period from 1997 through 2002, and is similar to that of all vehicle crashes in Michigan in the same years (Kostyniuk, 2003).

Tables 17-19 show the number and distribution of motorcycle crashes for each year from 1997 through 2002 by roadway condition, weather, and by light condition.

Table17. Motorcycle Crashes by Roadway Condition, 1997-2002							
	Dry	Wet	Icy	Snowy	Muddy	Debris	Other Unknown
1997	2,232 (88.8%)	191 (7.6%)	5 (0.2%)	4 (0.2%)	2 (0.1%)	33 (1.3%)	48 (1.9%)
1998	2,722 (91.7%)	178 (6.0%)	2 (0.1%)	0 (0.0%)	3 (0.1%)	22 (0.7%)	43 (1.5%)
1999	2,703 (93.5%)	107 (3.7%)	1 (0.1%)	2 (0.1%)	0 (0.0%)	33 (1.1%)	45 (1.6%)
2000	2,919 (92.6%)	142 (4.5%)	2 (0.1%)	4 (0.1%)	7 (0.2%)	30 (1.0%)	50 (1.6%)
2001	2,892 (92.4%)	145 (4.6%)	4 (0.1%)	2 (0.1%)	8 (0.3%)	34 (1.1%)	45 (1.4%)
2002	2,782 (93.0%)	116 (3.9%)	3 (0.1%)	1 (0.1%)	2 (0.1%)	35 (1.2%)	53 (1.8%)

Table 18. Motorcycle Crashes by Weather, 1997-2002							
	Clear	Cloudy	Fog, Smoke	Rain	Snow, Blowing Snow	Severe Wind	Other
1997	1,848 (73.1%)	524 (20.7%)	15 (0.6%)	123 (4.9%)	6 (0.2%)	2 (0.1%)	10 (0.4%)
1998	2,232 (74.8%)	621 (20.8%)	17 (0.6%)	105 (3.5%)	0 (0.0%)	0 (0.0%)	8 (0.3%)
1999	2,319 (79.9%)	487 (16.8%)	12 (0.4%)	67 (2.3%)	1 (0.1%)	3 (0.1%)	12 (0.4%)
2000	2,362 (74.7%)	679 (21.5%)	9 (0.3%)	87 (2.8%)	3 (0.1%)	4 (0.1%)	19 (0.6%)
2001	2,408 (76.4%)	628 (19.9%)	12 (0.4%)	86 (2.7%)	4 (0.1%)	2 (0.1%)	14 (0.4%)
2002	2,443 (81.1%)	458 (15.2%)	10 (0.3%)	82 (2.7%)	1 (0.1%)	2 (0.1%)	15 (0.5%)

Table19. Motorcycle Crashes by Light Condition,1997-2002						
	Daylight	Dawn	Dusk	Dark lighted	Dark unlighted	Other
1997	1,730 (68.7%)	36 (1.4%)	100 (4.0%)	349 (13.9%)	299 (11.9%)	4 (0.2%)
1998	2,015 (67.8%)	34 (1.1%)	140 (4.7%)	421 (14.2%)	358 (12.0%)	3 (0.1%)
1999	2,017 (69.7%)	32 (1.1%)	125 (4.3%)	402 (13.9%)	314 (10.9%)	5 (0.2%)
2000	2,186 (69.0%)	45 (1.4%)	147 (4.7%)	402 (12.8%)	371 (11.8%)	9 (0.3%)
2001	2,201 (69.7%)	36 (1.1%)	135 (4.3%)	417 (13.2%)	365 (11.6%)	6 (0.2%)
2002	2,128 (70.8%)	41 (1.4%)	145 (4.8%)	358 (11.9%)	326 (10.9%)	7 (0.2%)

The pattern of occurrence of motorcycle crashes by roadway condition, weather, and light condition was stable over the 6-years from 1997 through 2002. About 89-94% of crashes occurred on dry roads and 4-8% were on wet roads. About 73-81% of the crashes occurred in good weather, and 3-5% were in rain. Each year about 68-71% of crashes were in daylight, 12-14% were in dark, lighted conditions, and 11-12% were in dark, unlighted conditions. These patterns indicate that from 1997 through 2002, most motorcycle crashes occurred on dry roads, in good weather, and during the day.

## 4. SINGLE-AND MULTI-VEHICLE MOTORCYCLE CRASHES

### Number and Severity

In this section, crashes involving single motorcycles (single-vehicle) and crashes involving a motorcycle and other traffic units (multi-vehicle) are examined separately. Table 20 shows the number and proportion of motorcycle crashes that involved only a motorcycle, and crashes that involved a motorcycle with another vehicle(s) or pedestrian(s). Approximately one-half of motorcycle crashes were single-vehicle crashes and one-half involved other traffic units. This pattern was consistent over the 6 years from 1997 through 2002.

Table 20. Number and Proportion of Single- and Multi-Vehicle Motorcycle Crashes, 1997-2002			
	Type of Motorcycle Crash	Number of Crashes	% of all Motorcycle Crashes
1997	Single	1,243	48.9%
	Multi-Vehicle	1,300	51.1%
1998	Single	1,432	47.8%
	Multi-Vehicle	1,565	52.2%
1999	Single	1,424	48.9%
	Multi-Vehicle	1,490	51.1%
2000	Single	1,543	48.5%
	Multi-Vehicle	1,641	51.5%
2001	Single	1,638	50.9%
	Multi-Vehicle	1,578	49.1%
2002	Single	1,480	48.5%
	Multi-Vehicle	1,571	51.5%

Table 21 shows the distribution of other traffic units involved in collisions with motorcycles in multi-vehicle crashes from 1997 through 2002.

Table 21. Multi-Vehicle Motorcycle Crashes by Traffic Unit Mix, 1997-2002						
	With Car	With Truck	With Motorcycle	With Pedestrians or Other	With 2+ Traffic Units	Total
1997	822 (67.4%)	289 (23.7%)	28 (2.3%)	12 (1.0%)	69 (5.7%)	1,220 (100%)
1998	1,046 (70.2%)	312 (20.9%)	42 (2.8%)	9 (0.8%)	81 (5.4%)	1,490 (100%)
1999	982 (68.5%)	345 (23.2%)	26 (1.7%)	15 (1.0%)	65 (4.3%)	1,433 (100%)
2000	1,054 (67.3%)	345 (22.0%)	65 (4.2%)	21 (1.3%)	80 (5.1%)	1,565 (100%)
2001	1,001 (66.6%)	343 (22.8%)	49 (3.3%)	18 (1.2%)	91 (6.1%)	1,502 (100%)
2002	1,001 (67.1%)	357 (23.9%)	50 (3.4%)	13 (0.9%)	71 (4.8%)	1,492 (100%)

The distribution of traffic units involved in collisions with motorcycles did not change over the 6 years from 1997 through 2002. About two-thirds (67-70%) of the multi-vehicle crashes were with passenger cars, 21-24% were with trucks, 5-6% were with more than one other traffic unit, and about 1% were with pedestrians and other units (bicycles, etc).

Severity of single- and multi-vehicle motorcycle crashes is examined in Table 22 by comparing the number and distribution of people killed or injured in each type of crash.

Table 22. Number and Proportion of People Killed and Injured in Single- and Multi-vehicle Motorcycle Crashes, 1997-2002					
	Type of Motorcycle Crash	People Killed	% of All Motorcycle Fatalities	People Injured	% of all Motorcycle Crash Injuries
1997	Single	25	39.1%	1,061	47.3%
	Multi-Vehicle	39	60.9%	1,183	52.7%
1998	Single	18	33.3%	1,214	46.5%
	Multi-Vehicle	36	66.7%	1,397	53.5%
1999	Single	30	38.0%	1,210	47.6%
	Multi-Vehicle	49	62.0%	1,330	52.4%
2000	Single	24	30.0%	1,260	46.5%
	Multi-Vehicle	56	70.0%	1,447	53.5%
2001	Single	33	35.1%	1,317	48.7%
	Multi-Vehicle	61	64.9%	1,388	51.3%
2002	Single	30	36.6%	1,225	47.0%
	Multi-Vehicle	52	63.4%	1,379	53.0%

The proportions of people killed and injured in single- and multi-vehicle motorcycle crashes have not changed significantly over the 6-year time period. About 30-40% of all motorcycle fatalities and 46-49% of motorcycle injuries were sustained in single-vehicle crashes, while approximately 60-70% of all motorcycle fatalities and 51-54% of injuries occurred in multi-vehicle crashes.

### **Distributions by Age, Sex, and License**

The distributions of motorcyclists by age in single- and multi-vehicle motorcycle crashes for each year from 1997 through 2002 are shown in Table 23.

Table 23. Number and Proportion of Single- and Multi-Vehicle Motorcycle Crashes by Age of Driver, 1997-2002

	Type of Motorcycle Crash	≤18	19-29	30-44	45-64	65+	Total
1997	Single	157 (13.3%)	382 (32.3%)	383 (32.4%)	245 (20.7%)	16 (1.4%)	1,183 (100.0%)
	Multi-Vehicle	147 (11.4%)	491 (38.0%)	399 (38.9%)	241 (18.7%)	14 (1.1%)	1,292 (100.0%)
1998	Single	176 (12.8%)	435 (31.7%)	464 (33.8%)	280 (20.4%)	19 (1.4%)	1,374 (100.0%)
	Multi-Vehicle	177 (11.5%)	512 (33.2%)	526 (34.1%)	316 (20.5%)	12 (0.8%)	1,543 (100.0%)
1999	Single	148 (11.1%)	413 (31.0%)	435 (32.6%)	324 (24.3%)	13 (1.0%)	1,333 (100.0%)
	Multi-Vehicle	172 (11.8%)	457 (31.2%)	473 (32.3%)	344 (23.5%)	17 (1.2%)	1,463 (100.0%)
2000	Single	151 (10.2%)	440 (29.8%)	520 (35.3%)	342 (23.2%)	22 (1.5%)	1,475 (100.0%)
	Multi-Vehicle	201 (12.1%)	526 (31.7%)	521 (31.4%)	394 (23.7%)	19 (1.1%)	1,661 (100.0%)
2001	Single	159 (10.3%)	445 (28.8%)	524 (33.9%)	389 (25.2%)	28 (1.8%)	1,545 (100.0%)
	Multi-Vehicle	166 (10.5%)	467 (29.5%)	515 (32.5%)	412 (26.0%)	26 (1.6%)	1,586 (100.0%)
2002	Single	149 (10.5%)	358 (25.3%)	412 (29.0%)	475 (33.5%)	25 (1.8%)	1,419 (100.0%)
	Multi-Vehicle	196 (12.5%)	392 (25.0%)	525 (33.5%)	432 (27.6%)	23 (1.5%)	1,568 (100.0%)

Examining the age distributions of motorcyclists involved in both single- and multi-vehicle motorcycle crashes over the 6 years from 1997 through 2002, shows that they are similar to each other. An increase in the proportion of both single- and multi-vehicle crashes attributable to drivers age 45-64 over the 6 years is an evident trend.

Table 24 shows the distribution of crash-involved motorcyclists by sex for single- and multi-vehicle motorcycle crashes.

Table 24. Number and Proportion of Single- and Multi-Vehicle Motorcycle Crashes by Sex of Driver, 1997-2002			
	Type of Motorcycle Crash	Male	Female
1997	Single	1,117 (93.8%)	74 (6.2%)
	Multi-Vehicle	1,226 (94.8%)	67 (5.2%)
1998	Single	1,299 (94.1%)	82 (5.9%)
	Multi-Vehicle	1,494 (95.8%)	66 (4.2%)
1999	Single	1,292 (94.4%)	76 (5.6%)
	Multi-Vehicle	1,385 (94.5%)	81 (5.5%)
2000	Single	1,400 (94.7%)	78 (5.3%)
	Multi-Vehicle	1,563 (94.4%)	92 (5.6%)
2001	Single	1,518 (95.2%)	77 (4.8%)
	Multi-Vehicle	1,479 (94.4%)	88 (5.6%)
2002	Single	1,449 (93.1%)	107 (6.7%)
	Multi-Vehicle	1,331 (93.3%)	95 (6.7%)

The table reveals that women motorcyclists were involved in about 5-7% of the single-vehicle motorcycle crashes, and 4-7% of the multi-vehicle motorcycle crashes. The pattern of motorcycle crash involvement by sex of driver did not to vary by crash type and appears to be stable over the 6 years from 1997 through 2002.

Table 25 shows the number and proportion of licensed motorcyclists among crash-involved motorcyclists for each year from 1997 through 2002. There appears to be little difference in the proportions of licensed motorcyclists among those involved in single- and multi-vehicle motorcycle crashes over most of the 6 years. However, in 2002, 60% of those involved in single-vehicle crashes held drivers' licenses with a motorcycle endorsement,

while only 53% of those involved in multi-vehicle crashes had licenses with a motorcycle endorsement. Whether this is a chance variation or the beginning of a trend remains to be seen.

Table 25. Number and Proportion of Crash-Involved Licensed Motorcyclists by Crash Type, 1997-2002		
	Single Motorcycle Crash	Multi-Vehicle Crashes
1997	706 (56.8%)	721 (53.7%)
1998	811 (56.6%)	917 (56.4%)
1999	816 (57.3%)	833 (54.6%)
2000	850 (55.1%)	959 (55.3%)
2001	903 (55.1%)	912 (55.1%)
2002	881 (59.5%)	866 (52.8%)

### Other Drivers in Multi-vehicle Motorcycle Crashes

Table 26 shows the age distribution of the drivers of other vehicles involved in collisions with motorcycles.

Table 26. Age Distribution of Other Drivers Involved in Multi- Vehicle Motorcycle Crashes, 1997-2002						
	≤18	19-29	30-44	45-64	65+	Total
1997	349 (25.7%)	338 (24.9%)	302 (22.3%)	257 (18.9%)	111 (8.2%)	1,357 (100.0%)
1998	385 (23.7%)	437 (26.9%)	349 (21.5%)	311 (19.2%)	141 (8.7%)	1,623 (100.0%)
1999	381 (24.6%)	375 (24.2%)	374 (24.1%)	298 (19.2%)	122 (7.9%)	1,550 (100.0%)
2000	419 (24.8%)	430 (25.4%)	378 (22.3%)	333 (19.7%)	132 (7.8%)	1,692 (100.0%)
2001	352 (21.5%)	419 (25.6%)	394 (24.1%)	312 (19.1%)	160 (9.8%)	1,637 (100.0%)
2002	342 (21.2%)	405 (25.1%)	368 (22.8%)	341 (21.1%)	161 (10.0%)	1,617 (100.0%)

There was a decrease in the proportion of younger (age 18 years and less) drivers (from about 26% to 21%) balanced by small increases in the proportion of drivers over age 45. However, the distribution by age of other drivers involved in motorcycle crashes did not change significantly from 1997 through 2002. The proportions of other drivers by age are similar to that for all vehicle crashes (Kostyniuk and Miller, 2003).

Table 27 shows the distribution of the other drivers involved in motorcycle collisions by sex. Men comprised 55-59% of other drivers involved in motorcycle crashes from 1997 through 2002. This proportion reflects the general composition by sex of drivers on the road (Eby et al, 2002).

Table 27. Sex Distribution of Other Drivers Involved in Multi-vehicle Motorcycle Crashes, 1997-2002		
	Male	Female
1997	678 (55.2%)	550 (44.8%)
1998	853 (56.8%)	650 (43.2%)
1999	855 (59.1%)	591 (40.9%)
2000	877 (56.4%)	677 (43.6%)
2001	879 (57.4%)	652 (42.6%)
2002	859 (57.2%)	643 (42.8%)

## Hazardous Actions

The distributions of hazardous actions recorded by police for motorcycle drivers and other drivers in motorcycle crashes from 1997 through 2002 are examined in the next set of tables. Table 28 shows the distribution of hazardous actions recorded in single-vehicle motorcycle crashes.

Table 28. Hazardous Actions for Single-Vehicle Crash-Involved Motorcyclists, 1997-2002						
Hazardous Action	1997	1998	1999	2000	2001	2002
None	582 (48.0%)	680 (48.5%)	690 (49.5%)	760 (50.8%)	770 (49.2%)	747 (51.5%)
Speed too Fast	221 (18.2%)	251 (17.9%)	230 (16.5%)	214 (14.3%)	226 (14.4%)	215 (14.8%)
Speed too Slow	2 (0.2%)	1 (0.1%)	2 (0.1%)	4 (0.4%)	0 (0.0%)	1 (0.1%)
Fail to Yield	54 (4.5%)	41 (2.9%)	42 (3.0%)	42 (2.8%)	48 (3.1%)	35 (2.4%)
Traffic Control	16 (1.3%)	20 (1.4%)	19 (1.4%)	14 (1.0%)	16 (1.0%)	11 (0.9%)
Wrong Way	5 (0.4%)	2 (0.1%)	4 (0.3%)	1 (0.2%)	6 (0.5%)	4 (0.3%)
Left of Center	6 (0.5%)	8 (0.6%)	11 (0.8%)	8 (0.5%)	17 (1.1%)	5 (0.3%)
Improper Passing	19 (1.6%)	26 (1.9%)	14 (1.0%)	16 (1.1%)	20 (1.3%)	19 (1.3%)
Improper Lane Use	13 (1.1%)	17 (1.2%)	25 (1.8%)	17 (1.1%)	18 (1.2%)	17 (1.2%)
Improper Turn	5 (0.4%)	11 (0.8%)	7 (0.5%)	9 (0.6%)	10 (0.6%)	8 (0.6%)
Improper Signal	0 (0.0%)	3 (0.2%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	1 (0.1%)
Improper Backing	1 (0.1%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Clear Distance	94 (7.8%)	122 (8.7%)	126 (9.0%)	130 (8.7%)	108 (6.9%)	127 (8.8%)
Reckless Driving	—	—	—	33 (2.2%)	27 (1.7%)	20 (1.4%)
Careless/Negligent Driving	—	—	—	41 (2.7%)	70 (4.5%)	66 (4.6%)
Other	150 (12.4%)	157 (11.2%)	162 (11.6%)	145 (9.7%)	143 (9.1%)	103 (7.1%)
Unknown	44 (3.6%)	61 (4.4%)	64 (4.6%)	65 (4.3%)	87 (5.6%)	73 (5.0%)

The pattern of hazardous actions recorded for motorcyclists involved in single-vehicle crashes did not change significantly over the 6 years from 1997 through 2002. In about one-half (48-52%) of these crashes, no hazardous action was recorded. The most frequently recorded hazardous action for motorcyclists in single vehicle crashes was “speed too fast”

(14-18%). The second most frequent was “(failing to maintain) clear distance” (7-9%). It should be noted that the hazardous action categories “reckless driving” and “careless/negligent driving” were added to the codes in 2000. Together they were recorded for about 5-6% of motorcyclists involved in single-vehicle crashes from 2000 through 2002.

The distribution of hazardous actions recorded for motorcyclists involved in multi-vehicle crashes for each year from 1997 through 2002 is shown in Table 29.

Table 29. Hazardous Actions for Multi-Vehicle Crash-Involved Motorcyclists, 1997-2002						
Hazardous Action	1997	1998	1999	2000	2001	2002
None	629 (47.7%)	772 (48.5%)	742 (49.3%)	865 (50.9%)	749 (46.7%)	788 (50.5%)
Speed too Fast	227 (17.2%)	263 (16.5%)	254 (16.9%)	231 (13.6%)	277 (17.3%)	194 (12.4%)
Speed too Slow	2 (0.2%)	4 (0.3%)	4 (0.3%)	2 (0.1%)	2 (0.1%)	1 (0.1%)
Fail to Yield	53 (4.0%)	71 (4.5%)	48 (3.2%)	58 (3.4%)	39 (2.4%)	44 (2.8%)
Traffic Control	14 (1.1%)	19 (1.2%)	21 (1.4%)	20 (1.2%)	8 (0.5%)	20 (1.3%)
Wrong Way	3 (0.2%)	5 (0.3%)	6 (0.4%)	6 (0.4%)	4 (0.3%)	3 (0.2%)
Left of Center	9 (0.7%)	13 (0.8%)	11 (0.7%)	15 (0.9%)	7 (0.4%)	11 (0.7%)
Improper Passing	21 (1.6%)	24 (1.5%)	27 (1.8%)	24 (1.4%)	19 (1.2%)	23 (1.5%)
Improper Lane Use	19 (1.4%)	22 (1.4%)	14 (0.9%)	21 (1.2%)	12 (0.8%)	19 (1.2%)
Improper Turn	7 (0.5%)	15 (0.9%)	5 (0.3%)	7 (0.4%)	7 (0.4%)	6 (0.4%)
Improper Signal	2 (0.2%)	3 (0.2%)	4 (0.3%)	3 (0.2%)	0 (0.0%)	2 (0.1%)
Improper Backing	1 (0.1%)	0 (0.0%)	2 (0.1%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
Clear Distance	101 (7.7%)	125 (7.9%)	119 (7.9%)	125 (7.4%)	119 (7.4%)	123 (7.9%)
Reckless Driving	—	—	—	31 (1.8%)	43 (2.7%)	30 (1.9%)

Table 29. Hazardous Actions for Multi-Vehicle Crash-Involved Motorcyclists, 1997-2002						
Hazardous Action	1997	1998	1999	2000	2001	2002
Careless/Negligent Driving	—	—	—	62 (3.7%)	87 (5.4%)	81 (5.2%)
Other	164 (12.4%)	181 (11.4%)	182 (12.1%)	139 (8.2%)	147 (9.2%)	136 (8.7%)
Unknown	66 (5.0%)	74 (4.7%)	67 (4.5%)	89 (5.2%)	83 (5.2%)	79 (5.1%)

The pattern of hazardous actions recorded for motorcyclists in multi-vehicle crashes is similar to that of motorcyclists in single-vehicle crashes. In about one-half (48-51%) of these crashes, no hazardous action was recorded for the motorcyclist involved in the crash. “Speed too fast” was the most frequently recorded hazardous action, accounting for 12-17% of the crashes, and “(failing to maintain) clear distance” accounted for 7-8% of the crashes. From 2000 through 2002, “reckless driving” and “careless/negligent driving” together were recorded for 6-8% of motorcyclists in multi-vehicle crashes.

Table 30 shows the distribution of hazardous actions recorded for other drivers involved in multi-vehicle motorcycle crashes for each year from 1997 through 2002.

Table 30. Hazardous Actions by Other Drivers in Multi-Vehicle Motorcycle Crashes, 1997-2002						
Hazardous Action	1997	1998	1999	2000	2001	2002
None	584 (43.8%)	653 (41.2%)	609 (39.4%)	696 (41.5%)	630 (39.3%)	586 (37.4%)
Speed too Fast	9 (0.7%)	14 (0.9%)	12 (0.8%)	11 (0.7%)	8 (0.5%)	6 (0.4%)
Speed too Slow	4 (0.3%)	4 (0.3%)	1 (0.1%)	1 (0.1%)	1 (0.1%)	2 (0.1%)
Fail to Yield	346 (26.0%)	447 (28.2%)	451 (29.2%)	457 (27.3%)	450 (28.0%)	459 (29.3%)
Traffic Control	34 (2.6%)	43 (2.7%)	38 (2.5%)	52 (3.1%)	45 (2.8%)	32 (2.0%)
Wrong Way	1 (0.1%)	2 (0.1%)	2 (0.1%)	2 (0.1%)	1 (0.1%)	3 (0.2%)
Left of Center	9 (0.7%)	13 (0.8%)	7 (0.5%)	10 (0.6%)	18 (1.1%)	10 (0.6%)

Table 30. Hazardous Actions by Other Drivers in Multi-Vehicle Motorcycle Crashes, 1997-2002						
Hazardous Action	1997	1998	1999	2000	2001	2002
Improper Passing	10 (0.8%)	7 (0.4%)	19 (1.2%)	15 (0.9%)	12 (0.8%)	12 (0.8%)
Improper Lane Use	37 (2.8%)	38 (2.4%)	37 (2.4%)	42 (2.5%)	46 (2.9%)	43 (2.7%)
Improper Turn	46 (3.5%)	60 (3.8%)	53 (3.4%)	58 (3.5%)	45 (2.8%)	47 (3.0%)
Improper Signal	0 (0.0%)	9 (0.6%)	11 (0.7%)	10 (0.6%)	14 (0.9%)	6 (0.4%)
Improper Backing	26 (2.0%)	28 (1.8%)	33 (2.1%)	30 (1.8%)	27 (1.7%)	34 (2.2%)
Clear Distance	119 (8.9%)	151 (9.5%)	143 (9.2%)	157 (9.4%)	173 (10.8%)	164 (10.5%)
Reckless Driving	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (0.4%)	7 (0.4%)	7 (0.5%)
Careless/Negligent Driving	0 (0.0%)	0 (0.0%)	0 (0.0%)	15 (0.9%)	28 (1.7%)	32 (2.0%)
Other	72 (5.4%)	79 (5.0%)	94 (6.1%)	80 (4.8%)	63 (3.9%)	69 (4.4%)
Unknown	35 (2.6%)	36 (2.3%)	37 (2.4%)	34 (2.0%)	37 (2.3%)	55 (3.5%)

The pattern of hazardous actions recorded for other drivers in multi-vehicle motorcycle crashes was relatively stable over the 6 years from 1997 through 2002, but quite different from the hazardous actions recorded for motorcyclists in multi-vehicle crashes. Hazardous actions were recorded for a larger proportion of other drivers involved in crashes with motorcycles, than for crash-involved motorcyclists. The proportion of other drivers with no hazardous action recorded was 37-44% in the 6-years from 1997 through 2002, whereas, no hazardous action was recorded for 48-51% of the motorcyclists involved in the same crashes. “Failing to yield” (the right of way) was the most frequently recorded hazardous action, which accounted for 26-29% of the crashes. As with motorcyclists, the second most frequent action was “(failing to maintain) clear distance”, which was recorded for 9-11% of the other drivers in multi-vehicle motorcycle crashes.

Table 31 shows the number and proportion of motorcyclists and other drivers who received a citation for the hazardous action in the 6 years from 1997 through 2002.

Table 31. Number and Proportion of Drivers with a Hazardous Citation by Crash-Type, 1997-2002			
	Single-Vehicle Crashes	Multi-Vehicle Crashes	
	Motorcyclist	Motorcyclist	Other Driver
1997	184 (14.8%)	190 (14.1%)	361 (25.6%)
1998	213 (14.9%)	248 (15.3%)	461 (27.3%)
1999	214 (15.0%)	230 (15.1%)	478 (29.4%)
2000	256 (16.6%)	249 (14.4%)	516 (29.3%)
2001	209 (12.8%)	304 (18.4%)	485 (28.5%)
2002	174 (11.8%)	211 (12.9%)	508 (30.4%)

Two patterns are revealed by this table. First, the overall proportion of motorcyclists receiving citations for hazardous actions did not seem to vary by whether the crash was a single- or multi-vehicle crash. Furthermore, the proportion of motorcyclists receiving citations decreased slightly from 14-15% in 1997 to 12-13% in 2002. Second, the proportion of other drivers involved in multi-vehicle motorcycle crashes who received citations for a hazardous action was consistently higher than that of motorcyclists involved in the same crashes, and increased from 26% in 1997 to 30% in 2002.

### **Time, Location, and Environmental Conditions**

The distributions of single- and multi-vehicle motorcycle crashes from 1997 through 2002 were examined by month, day of week, time of day, road type, roadway condition, weather, and light condition. With the exception of the distributions of crashes by time of day and light condition, the distributions were very similar to that of all motorcycle crashes, and therefore are not discussed in this section, but can be found in Appendix B.

Tables 32 and 33 and Figures 4 and 5 show the distributions of single- and multi-vehicle motorcycle crashes by time of day.

Table 32. Single Motorcycle Crashes by Time of Day, 1997-2002								
	12:01 am to 3:00 am	3:01 am to 6:00 am	6:01 am to 9:00 am	9:01 am to 12 pm	12:01 pm to 3:00 pm	3:01 pm to 6:00 pm	6:01 pm to 9:00 pm	9:01 pm to 12:00 am
1997	140 (11.3%)	51 (4.1%)	74 (6.0%)	88 (7.1%)	171 (13.8%)	229 (18.5%)	284 (22.9%)	201 (16.2%)
1998	141 (10.0%)	67 (4.7%)	92 (6.5%)	94 (6.7%)	197 (13.9%)	276 (19.5%)	303 (21.4%)	244 (17.3%)
1999	138 (9.8%)	58 (4.1%)	53 (3.8%)	80 (5.7%)	193 (13.7%)	335 (23.8%)	330 (23.4%)	222 (15.8%)
2000	149 (9.8%)	49 (3.2%)	80 (5.3%)	95 (6.2%)	243 (16.0%)	327 (21.5%)	341 (22.4%)	239 (15.7%)
2001	127 (8.3%)	66 (4.3%)	83 (5.4%)	116 (7.6%)	236 (15.4%)	320 (20.9%)	336 (21.9%)	249 (16.2%)
2002	113 (8.1%)	52 (3.7%)	58 (4.2%)	108 (7.7%)	217 (15.5%)	326 (23.3%)	324 (23.2%)	201 (14.4%)

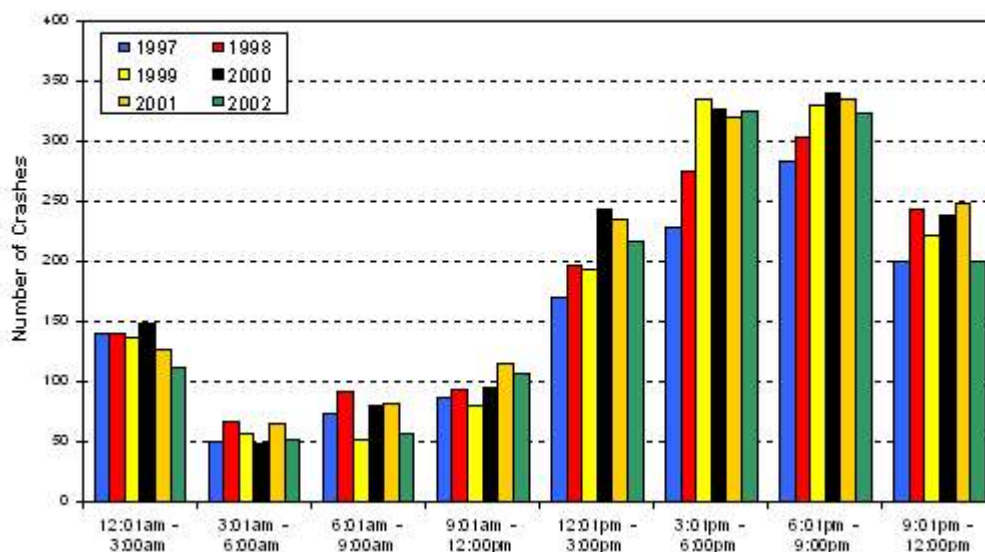


Figure 4. Single Motorcycle Crashes by Time of Day, 1997-2002

Table 33. Multi-Vehicle Motorcycle Crashes by Time of Day, 1997-2002								
	12:01 am to 3:00 am	3:01 am to 6:00 am	6:01 am to 9:00 am	9:01 am to 12 pm	12:01 pm to 3:00 pm	3:01 pm to 6:00 pm	6:01 pm to 9:00 pm	9:01 pm to 12:00 am
1997	57 (4.4%)	19 (1.5%)	81 ( 6.3%)	95 (7.4%)	233 (18.0%)	386 (29.9%)	267 (20.7%)	154 (11.9%)
1998	60 (3.9%)	30 (1.9%)	76 ( 4.9%)	142 (9.1%)	302 (19.4%)	433 (27.9%)	316 (20.3%)	195 (12.6%)
1999	67 (4.5%)	18 (1.2%)	75 (5.1%)	127 (8.6%)	279 (18.8%)	427 (28.85)	313 (21.1%)	179 (12.1%)
2000	67 (4.2%)	31 (1.9%)	73 (4.6%)	126 (7.9%)	311 (19.4%)	468 (29.3%)	350 (21.9%)	174 (10.9%)
2001	58 (3.9%)	19 (1.3%)	68 (4.6%)	95 (6.4%)	285 (19.3%)	439 (29.7%)	340 (23.05)	172 (11.7%)
2002	62 (4.2%)	13 (0.9%)	78 (5.3%)	132 (9.0%)	284 (19.3%)	424 (28.8%)	309 (21.0%)	173 (11.7%)

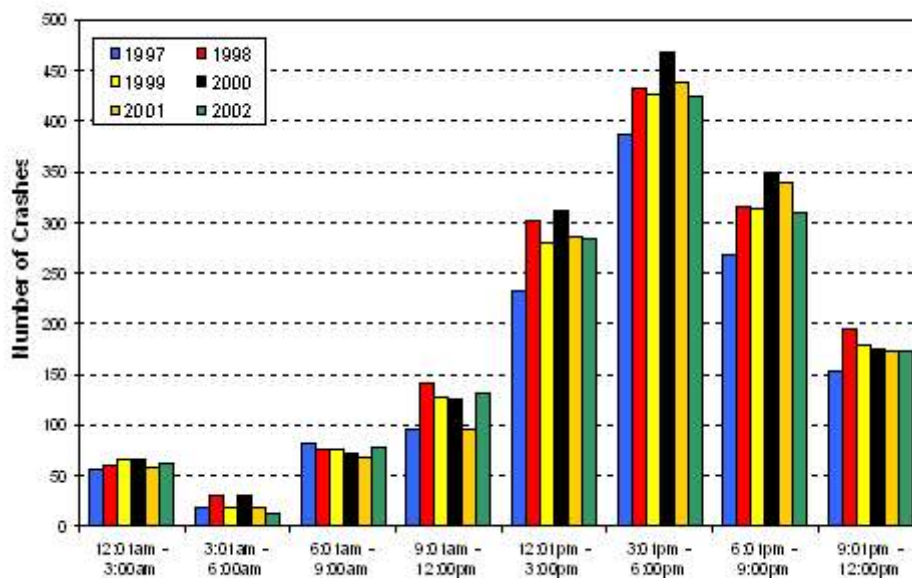


Figure 5. Multi-Vehicle Motorcycle Crashes by Time of Day, 1997-2002

Examination of these tables shows that a greater proportion of single-vehicle than multi-vehicle motorcycle crashes occurred at night. Approximately 23-27% of all single-vehicle motorcycle crashes occurred between 9:00 P.M. and 3:00 A.M., while 15-17% of the multi-vehicle crashes occurred during those hours.

Examining the crashes by light condition (Tables 34 and 35) shows again that a greater proportion of single-vehicle than multi-vehicle motorcycle crashes occurred at night, under dark lighted or unlighted conditions. Generally, 30-33% of all single-vehicle motorcycle crashes and 19-20% of multi-vehicle motorcycle crashes occurred at night. This pattern was somewhat different in 2001, when 20% of single-vehicle crashes were at night, and in 2002 when 28% of multi-vehicle crashes were at night. These departures from the pattern are most likely chance variations. However, this pattern should be monitored, in case it is the beginning of a trend.

Table 34. Single Motorcycle Crashes by Light Condition, 1997-2002						
	Daylight	Dawn	Dusk	Dark lighted	Dark unlighted	Other
1997	739 (59.9%)	24 (2.0%)	58 (4.7%)	173 (14.0%)	236 (19.1%)	3 (0.2%)
1998	859 (60.5%)	22 (1.6%)	85 (6.0%)	177 (12.5%)	275 (19.4%)	2 (0.1%)
1999	902 (63.8%)	24 (1.7%)	74 (5.2%)	179 (12.7%)	233 (16.5%)	3 (0.2%)
2000	943 (61.8%)	30 (2.0%)	87 (5.7%)	183 (12.0%)	276 (18.1%)	7 (0.5%)
2001	1,172 (75.7%)	8 (0.5%)	56 (3.6%)	223 (14.4%)	88 (5.7%)	2 (0.1%)
2002	1,176 (76.2%)	16 (1.0%)	72 (4.7%)	198 (12.8%)	81 (16.8%)	0 (0.0%)

Table 35. Multi-Vehicle Motorcycle Crashes by Light Condition, 1997-2002						
	Daylight	Dawn	Dusk	Dark lighted	Dark unlighted	Other
1997	991 (77.1%)	12 (0.9%)	42 (3.3%)	176 (13.7%)	63 (4.9%)	1 (0.1%)
1998	1,156 (74.5%)	12 (0.8%)	55 (3.6%)	244 (15.7%)	83 (5.4%)	1 (0.1%)
1999	1,115 (75.3%)	8 (0.5%)	51 (3.5%)	223 (15.1%)	81 (5.5%)	2 (0.1%)
2000	1,125 (75.8%)	15 (0.9%)	60 (3.7%)	219 (13.6%)	95 (5.9%)	2 (0.1%)
2001	1,172 (75.7%)	8 (0.5%)	56 (3.6%)	223 (14.4%)	88 (5.7%)	2 (0.1%)
2002	952 (65.1%)	25 (1.7%)	73 (5.0%)	160 (10.9%)	245 (16.8%)	7 (0.5%)

## 5. HAD BEEN DRINKING (HBD) CRASHES

### Number and Severity

Table 36 shows the number and proportion of motorcycle crashes in which a motorcyclists or driver of the other vehicle had been drinking. The number of HBD crashes involving motorcycles decreased by almost 4% from 1997, despite a 20% increase in motorcycle crashes. The proportion of HBD crashes among motorcycle crashes decreased from almost 12% in 1997 to 9% in 2002. In approximately 87% of HBD motorcycle crashes each year, the motorcyclist was the driver who had been drinking.

Table 36. Number and Proportion of HBD Crashes Involving Motorcycles, 1997-2002					
Year	All Motorcycle Crashes	HBD Crashes Involving Motorcycles		HBD Crashes Involving Motorcyclist who had been Drinking	
		Number	Percent of All	Number	Percent of All
1997	2,543	295	11.6%	256	10.1%
1998	2,997	348	11.6%	300	10.0%
1999	2,914	329	11.3%	291	10.0%
2000	3,184	278	8.7%	243	7.6%
2001	3,216	308	9.6%	275	8.6%
2002	3,051	284	9.3%	237	7.8%
% Change 1997-2002	20.0%	-3.7%	-2.3%	-7.4%	-2.3%

The number and proportion of motorcyclists who had been drinking in single-vehicle motorcycle HBD crashes and the number and proportion of motorcyclists and other drivers who had been drinking in multi-vehicle motorcycle HBD crashes is shown in Table 37 for each year from 1997 through 2002.

Table 37. Number and Proportion of Single- and Multi-Vehicle Motorcycle Crashes Involving Had Been Drinking Drivers, 1997-2002			
	Single -Vehicle Crash	Multi-Vehicle Crash	
	Motorcyclist HBD	Motorcyclist HBD	Other Driver HBD
1997	129 (10.4%)	127 (9.4%)	47 (3.3%)
1998	158 (11.0%)	142 (8.7%)	60 (3.6%)
1999	147 (10.3%)	144 (9.4%)	54 (3.3%)
2000	120 (7.8%)	123 (7.1%)	48 (2.7%)
2001	128 (7.8%)	147 (8.9%)	51 (3.0%)
2002	127 (8.6%)	110 (6.7%)	60 (3.6%)
% Change 1997-2002	-1.6%	-13.4%	0.27

From 1997 through 2002, 8-11% of single-vehicle motorcycle crashes involved a motorcyclist who had been drinking. During those 6 years, the proportion of motorcyclists involved in multi-vehicle crashes who had been drinking ranged from 7% to 9%. Thus, it appears that the proportion of motorcyclists who had been drinking is slightly higher among single-vehicle than in multi-vehicle motorcycle crashes. In about 3-4% of HBD crashes involving other vehicles, the drivers of the other vehicle had been drinking. Note that the total of had-been-drinking drivers exceeds the number of HBD crashes in Table 36 because in a small number of the HBD multi-vehicle crashes, both the motorcyclist and other driver had been drinking.

Table 38 shows the number and proportion of people killed and injured in HBD motorcycle crashes.

Table 38. Number and Proportion of People Killed and Injured in HBD Motorcycle Crashes, 1997-2002								
		1997	1998	1999	2000	2001	2002	% change 1997-2002
<b>Persons Killed</b>	All Motorcycle Crashes	64	54	79	80	94	82	28.1%
	HBD Motorcycle Crashes (% of all)	30 (46.9%)	23 (42.6%)	36 (45.6%)	27 (33.8%)	33 (35.1%)	24 (29.3%)	-20.0% -
<b>Persons Injured</b>	All Motorcycle Crashes	2,238	2,611	2,540	2,707	2,767	2,607	16.5%
	HBD Motorcycle Crashes (% of all)	302 (13.5%)	357 (13.7%)	318 (12.5%)	275 (10.2%)	304 (11.1%)	270 (10.4%)	-10.6% -

Although HBD crashes accounted for 9-12% of motorcycle crashes from 1997 through 2002, they accounted for a much larger proportion of fatalities. In 1997, 47% of fatalities in motorcycle crashes were in HBD crashes, decreasing to 29% in 2002. Between 1997 and 2002, the number non-fatal injuries sustained in HBD motorcycle crashes decreased by nearly 11%, and their proportion among all motorcycle injuries decreased from almost 14% to about 10%.

### Distributions of HBD Motorcycle Crashes by Age and Sex

The distribution by age of crash-involved motorcyclists who had been drinking (Table 39) shows a 7% overall reduction in the number of crash-involved motorcyclists who had been drinking. However, the table also shows large increases in the number of had-been-drinking crash-involved motorcyclists among those 18 and younger and age 45-64 years. Although the actual number of young crash-involved, had-been-drinking motorcyclists was quite small, the increase in the number of their crashes was 55%. The number of crash-involved, had been-drinking motorcyclists age 45-64, increased by 71% from 1997 through 2002.

Table 39. Number and Proportion of Crash-Involved Motorcyclists Who Had Been Drinking by Age, 1997-2002						
	≤18	19-29	30-44	45-64	65+	Total
1997	5 (2.1%)	68 (28.5%)	124 (51.9%)	41 (17.2%)	1 (0.4%)	239 (100.0%)
1998	14 (4.9%)	84 (29.4%)	131 (45.8%)	56 (19.6%)	1 (0.3%)	286 (100.0%)
1999	5 (1.8%)	70 (25.5%)	139 (50.7%)	60 (21.9%)	0 (0.0%)	274 (100.0%)
2000	10 (3.8%)	59 (22.9%)	132 (51.2%)	55 (21.3%)	2 (0.8%)	258 (100.0%)
2001	8 (3.4%)	52 (22.2%)	120 (51.3%)	53 (22.6%)	1 (0.4%)	234 (100.0%)
2002	11 (4.9%)	52 (23.3%)	89 (39.9%)	70 (31.4%)	1 (0.4%)	223 (100.0%)
% change 1997-2002	54.5%	-23.5%	-28.2%	70.7%	0.0%	-6.7%

Table 40 shows that the proportion by sex of crash-involved, had-been drinking motorcyclists has not changed significantly from 1997 through 2002. About 96-99% of all crash-involved had-been-drinking motorcyclists were men, and 1-4% were women in each of the 6 years.

Table 40. Number and Proportion of HBD Motorcyclists by Sex, 1997-2002		
	Male	Female
1997	242 (96.0%)	10 (4.0%)
1998	288 (96.3%)	11 (3.7%)
1999	285 (99.0%)	3 (1.0%)
2000	263 (96.7%)	9 (3.3%)
2002	226 (96.2%)	9 (3.8%)
2001	233 (97.1%)	7 (2.9%)

## BAC Levels in Fatal Crashes

Blood alcohol concentration (BAC) information for motorcyclists involved in fatal crashes was obtained from FARS data. In general, about 50% of fatal-crash-involved motorists in Michigan are tested for BAC (Kostyniuk and Miller, 2003). However, the proportion of motorcyclists tested was higher. From 1997 through 2001, 64-84% of fatal-crash-involved motorcyclists were tested for BAC (Table 41). As noted earlier, FARS data for 2002 were not available at the time this report was prepared.

Table 41. Fatal-Crash-Involved Motorcyclists Tested for BAC, 1997-2001			
	Tested	Not Tested	Total*
1997	38 (64.4%)	21 (35.6%)	59 (100%)
1998	41 (83.7%)	8 (16.3%)	49 (100%)
1999	61 (76.2%)	19 (23.8%)	80 (100%)
2000	55 (66.3%)	28 (33.7%)	83 (100%)
2001	63 (73.3%)	23 (26.7%)	86 (100%)

\* There was a small number of missing cases in each year.

Table 42 shows the BAC level of fatal-crash-involved motorcyclists who had been tested. Of the tested motorcyclists each year, 44-60% had BAC levels of 0 g/dl, 5-13% had BAC levels between 0 and 0.08 g/dl, and 29-36% had BAC at or over 0.08 g/dl. BAC test results were not reported for 5-8% of the motorcyclists.

Table 42. BAC Levels (g/dl) of Fatal-Crash-Involved Motorcyclists, 1997-2001						
	BAC=0.00	0.0<BAC<0.08	0.08≤BAC<0.10	BAC≥0.10	Results Unknown	Total
1997	20 (52.6%)	4 (10.5%)	0 (0.0%)	11 (28.9%)	3 (7.9%)	38 (100%)
1998	23 (56.1%)	3 (7.3%)	1 (2.4%)	12 (29.3%)	2 (4.9%)	41 (100%)
1999	27 (44.3%)	8 (13.1%)	1 (1.6%)	21 (34.4%)	4 (6.6%)	61 (100%)
2000	30 (54.5%)	7 (12.7%)	1 (1.8%)	14 (25.5%)	3 (5.5%)	55 (100%)
2001	38 (60.3%)	3 (4.8%)	3 (4.8%)	16 (25.4%)	3 (4.8%)	63 (100%)

## Time of Occurrence

Table 43 shows the distribution of HBD motorcycle crashes by month for each year from 1997 through 2002. The peak months for motorcycle HBD crashes in 1997 through 2002 were June, July, and August, although in some years, May or September could be included among the peak months. This pattern in peak months for HBD motorcycle crashes resembles the pattern of peak months for all motorcycle crashes.

Table 43. HBD Motorcycle Crashes by Month, 1997-2002												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1997	0 (0.0)	0 (0.0)	4 (1.6)	11 (4.3)	31 (12.1)	48 (18.8)	65 (25.4)	36 (14.1)	24 (9.4)	30 (11.7)	6 (2.3)	1 (0.4)
1998	0 (0.0)	3 (1.0)	10 (3.3)	19 (6.3)	40 (13.3)	40 (13.3)	47 (15.7)	48 (16.0)	54 (18.0)	33 (11.0)	4 (1.3)	2 (0.7)
1999	1 (0.3)	3 (1.0)	2 (0.7)	21 (7.2)	41 (14.1)	49 (16.8)	53 (18.2)	40 (13.8)	49 (16.8)	20 (6.9)	10 (3.4)	2 (0.7)
2000	0 (0.0)	0 (0.0)	5 (1.8)	26 (9.5)	31 (11.3)	41 (14.9)	50 (18.2)	45 (16.4)	37 (13.5)	20 (7.3)	15 (5.5)	5 (1.8)
2001	2 (0.8)	3 (1.2)	8 (3.3)	24 (9.9)	29 (11.9)	41 (16.9)	38 (15.6)	41 (16.9)	18 (7.4)	31 (12.8)	5 (2.1)	3 (1.2)
2002	1 (0.8)	1 (0.4)	3 (1.3)	6 (2.5)	21 (8.9)	56 (23.6)	52 (21.9)	42 (17.7)	35 (14.8)	10 (4.2)	9 (3.8)	0 (0.0)

Table 44 shows the pattern of HBD motorcycle crashes by day of week. The majority (57-68%) of HBD crashes occurred on Fridays, Saturdays, and Sundays. Saturdays were the peak days for HBD motorcycle crashes in 5 of the 6 years from 1997 through 2002.

Table 44. HBD Motorcycle Crashes by Day of Week, 1997-2002							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1997	65 (25.4%)	21 (8.2%)	22 (8.6%)	7 (6.6%)	26 (10.2%)	35 (13.7%)	70 (17.3%)
1998	64 (21.3%)	27 (9.0%)	22 (7.3%)	22 (7.3%)	35 (11.7%)	52 (17.3%)	78 (26.0%)
1999	68 (23.4%)	21 (7.2%)	24 (8.3%)	22 (7.6%)	27 (9.3%)	51 (17.5%)	78 (26.8%)
2000	51 (18.6%)	27 (9.8%)	21 (7.6%)	34 (12.4%)	29 (10.6%)	48 (17.5%)	65 (23.6%)
2001	54 (22.2%)	19 (7.8%)	17 (7.0%)	17 (7.0%)	27 (11.1%)	45 (18.5%)	64 (26.3%)
2002	29 (12.2%)	18 (7.6%)	26 (11.0%)	16 (6.8%)	35 (14.8%)	35 (14.8%)	78 (32.9%)

The occurrence of motorcycle HBD crashes is examined by time of day in Table 45, and shown graphically in Figure 6.

Table 45. HBD Motorcycle Crashes by Time of Day, 1997-2002								
	12:01 am to 3:00 am	3:01 am to 6:00 am	6:01 am to 9:00 am	9:01 am to 12 pm	12:01 pm to 3:00 pm	3:01 pm to 6:00 pm	6:01 pm to 9:00 pm	9:01 pm to 12:00 am
1997	66 (25.9%)	18 (7.1%)	4 (1.6%)	3 (1.2%)	15 (5.9%)	26 (10.2%)	55 (21.6%)	68 (26.7%)
1998	76 (25.8%)	26 (8.8%)	6 (2.0%)	3 (1.0%)	7 (2.4%)	20 (6.8%)	67 (22.7%)	90 (30.5%)
1999	73 (25.2%)	22 (7.6%)	2 (0.7%)	4 (1.4%)	10 (3.5%)	34 (11.7%)	61 (21.0%)	84 (29.0%)
2000	64 (24.2%)	18 (6.8%)	3 (1.1%)	2 (0.8%)	6 (2.3%)	32 (12.1%)	69 (26.1%)	70 (26.5%)
2001	67 (29.0%)	11 (4.8%)	3 (1.3%)	1 (0.4%)	5 (2.2%)	27 (11.7%)	59 (25.5%)	58 (25.1%)
2002	68 (30.4%)	10 (4.5%)	1 (0.5%)	1 (0.5%)	4 (1.8%)	31 (13.8%)	46 (20.5%)	63 (28.1%)

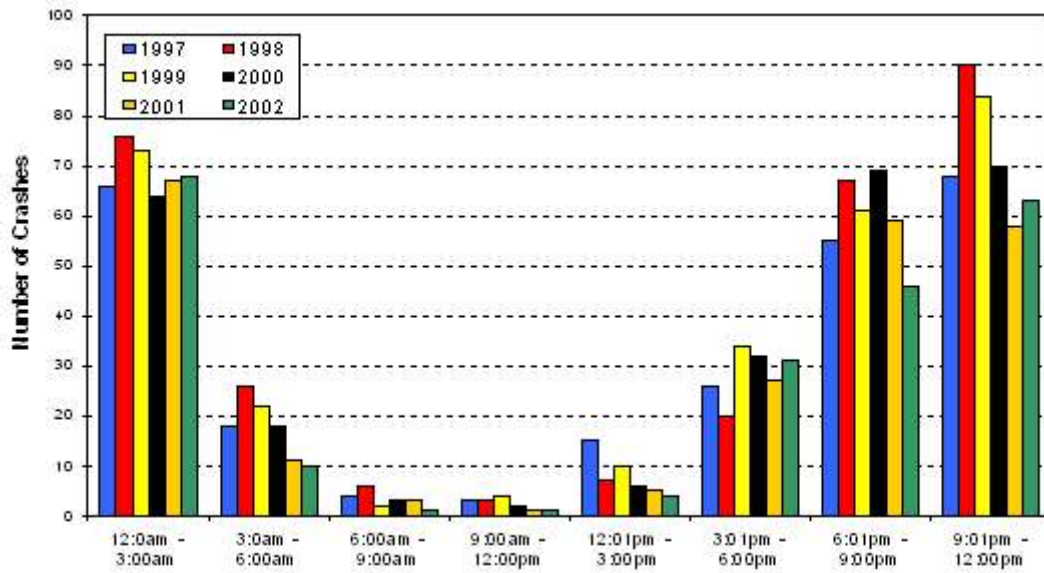


Figure 6. HBD Motorcycle Crashes by Time of Day, 1997-2002

The pattern of motorcycle HBD crashes by time of day has not changed significantly over the 6 years from 1997 through 2002. Approximately three-quarters (74-80%) of all motorcycle HBD crashes occurred from 6:00 P.M. to 3:00 A.M.

## 6. HELMET USE

Michigan law requires that motorcyclists and motorcycle passengers wear DOT-approved helmets when riding motorcycles (Michigan Vehicle Code Section 257.658). Table 46 shows the helmet use of crash-involved motorcyclists for 1997 through 2002. Information on helmet use of motorcycle drivers was available for approximately 85% of motorcycle crashes. Helmet use for motorcycle passengers is shown only for 1997 and 1998, because data for 1999-2002 on passenger helmet use were not consistently coded.

Table 46. Number and Proportion of Helmet use for Crash-Involved Motorcycle Drivers and Passengers, 1997-2002				
	Driver		Passenger*	
	Helmet Worn	No Helmet	Helmet Worn	No Helmet
1997	1,557 (94.0%)	100 (6.0%)	149 (92.0%)	13 (8.0%)
1998	1,866 (94.5%)	108 (5.5%)	161 (95.3%)	8 (4.7%)
1999	1,815 (95.3%)	90 (4.7%)	-	-
2000	1,917 (95.9%)	82 (4.1%)	-	-
2001	2,010 (96.6%)	71 (3.4%)	-	-
2002	1,956 (96.5%)	70 (3.5%)	-	-

\* Data not available for 1999-2002

As can be seen from Table 46, helmet use among motorcycle drivers, already quite high at 94% in 1997, increased to 97% by 2002. From the limited data on passenger helmet use, it appears that helmet use among motorcycle passengers is comparable to that of motorcycle drivers.

Table 47 shows the proportion of crash-involved motorcycle drivers who were killed, sustained an incapacitating injury (A level injury as defined in State of Michigan, 1999), sustained other injuries (B or C level as defined in State of Michigan, 1999), or were

uninjured while wearing a helmet.

Table 47. Injury Severity of Crash-Involved Motorcycle Drivers by Helmet Use, 1997-2002						
		Killed	Incapacitating Injury	Other Injury	No Injury	Total
1997	Helmet Worn	32 (2.1%)	351 (22.5%)	850 (54.6%)	324 (20.8%)	1,557 (100%)
	No Helmet	7 (7.0%)	27 (27.0%)	51 (51.0%)	15 (15.0%)	100 (100%)
1998	Helmet Worn	35 (1.9%)	415 (22.2%)	973 (52.1%)	443 (23.6%)	1,866 (100%)
	No Helmet	5 (4.6%)	32 (29.6%)	60 (55.6%)	11 (10.2%)	108 (100%)
1999	Helmet Worn	49 (2.7%)	361 (19.9%)	1,011 (55.7%)	394 (21.7%)	1,815 (100%)
	No Helmet	3 (10.0%)	26 (28.9%)	54 (60.0%)	7 (7.8%)	90 (100%)
2000	Helmet Worn	53 (2.8%)	366 (19.1%)	1,058 (55.2%)	440 (22.9%)	1,917 (100%)
	No Helmet	4 (4.9%)	25 (30.5%)	43 (52.4%)	10 (12.2%)	82 (100%)
2001	Helmet Worn	61 (3.0%)	383 (19.1%)	1,110 (55.2%)	456 (22.7%)	2,010 (100%)
	No Helmet	3 (4.2%)	20 (28.2%)	37 (52.1%)	11 (15.5%)	71 (100%)
2002	Helmet Worn	59 (3.0%)	389 (19.9%)	1,060 (54.2%)	448 (22.9%)	1,956 (100%)
	No Helmet	0 (0.0%)	19 (27.1%)	43 (61.4%)	8 (11.4%)	70 (100%)

The severity of injuries among motorcyclists not wearing helmets was greater than among motorcyclists wearing helmets. From 1997 through 2002, 2-3% of crash-involved motorcyclists wearing helmets were killed in the crash. The proportion of those not wearing helmets who were killed ranged from 0% to 10% in the 6 years. Of crash-involved motorcyclists wearing helmets, 20-23% sustained incapacitating injuries, as compared to 27-31% of those not wearing helmets. Furthermore, 21-24% of crash-involved motorcyclists wearing helmets were not injured at all, while only 8-16% of those not wearing helmets were not injured in the crash.

## 7. NOTABLE TRENDS AND DISCUSSION

### Trends and Patterns

The salient patterns and trends in motorcycle crashes in Michigan from 1997 through 2002 are summarized below:

#### ***Increase in number of motorcycle crashes, and related deaths and injuries***

- ! There has been a 20% increase in the number of motorcycle crashes in Michigan from 1997 through 2002. The increase in fatal crashes involving motorcycles was 27%, and the increase in non-fatal injury crashes involving motorcycles was 19%. During the same time, the number of all vehicle crashes in Michigan decreased by 7%, fatal crashes decreased by 8%, and injury crashes decreased by 16%.
- ! About 77-78% of motorcycle crashes in Michigan result in a death or injury. In contrast, about 20-23% of vehicle crashes in Michigan result in a death or injury.
- ! Although the proportion of vehicle crashes in Michigan involving motorcycles increased each year from 1997, in 2002, motorcycle crashes represented less than 1% of all vehicle crashes. However, each year from 1997 through 2002, motorcycle crashes accounted for 4-8% of all fatal crashes.
- ! The proportion of fatal crashes among motorcycle crashes did not change significantly between 1997 and 2002. In 1997, 2.5% of motorcycle crashes involved a fatality, and in 2002, 2.6% of motorcycle crashes involved a fatality.

#### ***Increase in registered motorcycles and decrease in vehicle crash rate***

- ! The number of registered motorcycles in Michigan increased by 45% from 136,030 in 1997 to 197,735 in 2002.
- ! The crash rate per registered motorcycle decreased by 18% from 18.7 crashes per 1,000 registered motorcycles in 1997 to 15.4 crashes per 1,000 registered motorcycles in 2002.

#### ***Increase in the number and aging of licensed motorcyclists***

- ! The number of people with motorcycle endorsements on drivers' licenses increased by 7.5% from 433,405 in 1997 to 465,786 in 2002. About 93-94% of licensed motorcyclists are men.

- ! There has been an aging of the licensed motorcyclists in Michigan. In 1997, 45% of licensed motorcyclists were age 45 or older, while in 2002, 59% of licensed motorcyclists were age 45 or older.
- ! The number of licensed motorcyclists younger than 45 years decreased by 20% between 1997 and 2002.

### ***Changes in driver crash rates***

- ! The crash rate per licensed motorcyclist increased by 12% from 5.9 crashes per 1,000 licensed motorcyclists in 1997 to 6.6 crashes per 1,000 licensed motorcyclists in 2002.
- ! The youngest motorcyclists had the highest crash rate. In 2002, the crash rate for motorcyclists younger than 19 years was 451 crashes per 1,000 licensed motorcyclists.
- ! The lowest crash rate was among motorcyclists age 65 and older consistently. Their crash rate in 2002 was 1.7 crashes per 1,000 licensed motorcyclists.
- ! The largest increase in crash rate was among motorcyclists age 30-44. The crash rate increased by 53% from 3.8 to 5.8 crashes per 1,000 licensed motorcyclists.
- ! The crash rate for motorcyclists age 45-64 increased by 32%, from 2.8 crashes per 1,000 licensed motorcyclists in 1997 to 3.7 crashes per 1,000 licensed motorcyclists in 2002.

### ***Unlicensed motorcyclists***

- ! About 44% of motorcyclists involved in crashes in Michigan from 1997 through 2002 did not have a valid motorcycle endorsement on this driver's license, i.e. they were not legally licensed to operate a motorcycle.
- ! Approximately 10% of crash-involved motorcyclists did not have drivers' licenses of any type.
- ! The largest proportion of unlicensed motorcyclists was among those age 18 and younger. In 2002, only 23% of crash-involved motorcyclists in this age group were legally licensed to operate a motorcycle, and 54% did not have drivers' licenses of any type.

### ***Time and Conditions of Crash Occurrence***

- ! The patterns of motorcycle crashes by month, day of week, and time of day have not changed in the 6 years from 1997 through 2002. The peak months of motorcycle crashes were June, July, and August. The peak days were Saturdays followed by Sundays, and the peak hours were between 3:00 P.M. and 6:00 P.M.
- ! Most motorcycle crashes occurred on dry roads, in good weather, and in daylight.
- ! Single-vehicle motorcycle crashes were more likely to occur at night than multi-vehicle crashes. About 45-50% of single-vehicle motorcycle crashes occurred between 6:00 P.M. and 3:00 A.M.
- ! Approximately 75% of HBD motorcycle crashes occurred between 6:00 P.M. and 3:00 A.M.

### ***Single- and Multi-Vehicle Motorcycle Crashes***

- ! The patterns of motorcycle crashes by whether they involved only the motorcycle or a collision between the motorcycle and another vehicle did not change from 1997 through 2002,
- ! About one-half of the motorcycle crashes involved only the motorcycle.
- ! About 47% of all injuries and 35% of fatalities in motorcycle crashes occurred in single-vehicle motorcycle crashes.
- ! Just over one-half of all injuries and 65% of fatalities occurred in multi-vehicle motorcycle crashes.

### ***Hazardous Actions***

- ! Patterns of hazardous actions recorded for motorcyclists in single- and multi-vehicle crashes were similar to each other, and did not change from 1997 through 2002.
- ! Hazardous actions were recorded for approximately one-half of crash-involved motorcyclists, and for 56-63% of other drivers in multi-vehicle motorcycle crashes.
- ! The most frequently recorded hazardous actions for motorcyclists regardless of crash type, were speeding (about 13-18 % of crashes), (failure to maintain) clear distance (7-9%), and reckless, careless, and negligent driving (5-8%).
- ! Failure to yield right of way was the most frequently recorded hazardous action for other drivers in multi-vehicle motorcycle crashes (26-29% of all multi-vehicle crashes).

- ! About 15% of crash-involved motorcyclists, and 26-30% of crash-involved other drivers received citations for hazardous actions.

### ***Had-Been-Drinking (HBD) Crashes***

- ! There has been a 4% decrease in the number of motorcycle crashes in which a motorcyclist or other driver had been drinking, and a 20% decrease in the number of fatalities from these crashes. The proportion of all motorcycle fatalities that resulted from HBD crashes also decreased. In 1997, 47% of motorcycle crash fatalities were from HBD crashes, and in 2002, the proportion of motorcycle crash fatalities from HBD crashes was 29%.
- ! In 2002, 9% of motorcycle crashes involved a motorcyclist or other driver who had been drinking. This was a decrease from 1997, when 12% of all motorcycle crashes involved a drinking motorcyclist or other driver.
- ! Each year from 1997 through 2002, 8-11% of single-vehicle motorcycle crashes involved motorcyclists who had been drinking.
- ! In multi-vehicle motorcycle crashes, 7-9% of motorcyclists and 3-4% of other drivers had been drinking alcohol.
- ! There has been an increase of 71% in the number of motorcycle crashes involving motorcyclists age 45-64, who had been drinking.
- ! Motorcyclists are more likely to be tested for BAC than drivers involved in other (non-motorcycle) fatal crashes. Overall, approximately 50% of drivers involved in fatal crashes are tested for BAC. However, the proportion of motorcyclists involved in fatal crashes who were tested for BAC varied from 64% to 84% over the 6-year period.
- ! Of motorcyclists involved in fatal crashes who were tested, 29-36% had BAC levels at or exceeding 0.08 g/dl.

### ***Helmet Use***

- ! Helmet use among crash-involved motorcycle drivers increased from 94% in 1997 to 97% in 2002.
- ! Injuries were more severe among motorcyclists not wearing helmets than among motorcyclists wearing helmets. From 1997 through 2002, 23-25% of crash-involved motorcyclists with helmets were killed or sustained incapacitating injuries, while 27-

39% of crash-involved motorcyclists without helmets were killed or sustained incapacitating injuries.

## **Discussion**

The increase in motorcycle activity as evidenced by the number of motorcycles and motorcyclists in Michigan parallels that in the U.S. in general. Between 1997 and 2001, the number of motorcycles in the U.S. has increased by 28% and by 41% in Michigan. By 2002, motorcycles constituted 2.2% of registered vehicles in the U.S., and 2.0% of registered vehicles in Michigan. There has also been an increase in motorcycle crashes, and deaths and injuries associated with these crashes. Nationally, the number of deaths in motorcycle crashes increased by 53% between 1997 and 2002, and crashes involving motorcycles accounted for 7.6% of total traffic fatalities (NHTSA, 2003b, 2003d). Between 1997 and 2002, the increase in the number of deaths from motorcycle crashes in Michigan was 28%, and motorcycle crash fatalities accounted for 6.4% of vehicle crash fatalities in the state in 2002.

Despite the increase in the number of motorcycle crashes and in deaths resulting from these crashes, the proportion of motorcycle crashes that resulted in death or injury has not changed in Michigan between 1997 and 2002. Because motorcycles inherently offer less protection to their occupants in a crash than automobiles, the likelihood of death or injury in a motorcycle crash is much higher than in a crash involving an automobile. Thus, if the probability of a motorcycle being in a crash remains the same, and the probability of a death or injury in a motorcycle crash also remains the same, an increase in the number of motorcycles on the road will increase the number of motorcycle crashes, and also the total number of deaths and injuries from these crashes. It can be argued that the present increase in motorcycle crashes, deaths, and injuries in Michigan is simply a consequence of the increase of motorcycles on the road.

Crash rates provide a measure of the probability of a crash, and changes in the crash rate per vehicle, driver, and vehicle miles of travel (VMT) indicate changes in traffic safety. Analysis of the crash data and vehicle registrations showed a 18% decrease in the crash rate per registered motorcycle from 18.7 to 15.4 crashes per 1,000 registered motorcycles

between 1997 and 2002. Overall, this is a positive indication of improvement in motorcycle safety, and indicates that the probability of a motorcycle being in a crash has decreased. However, the crash rate per licensed motorcyclist increased by 12%. The crash rate for motorcycle VMT could not be determined because VMT data are not directly available for motorcycles in Michigan.

The changes in crash rates by registered motorcycle and by licensed motorcyclist give contradicting indications of changes in motorcycle safety. However, the number of licensed motorcyclists is not an accurate measurement of people operating motorcycles on Michigan's roads. Of crash-involved motorcyclists, only approximately 56% were licensed to operate motorcycles. The number of motorcyclists could be estimated by assuming that 56% of all motorcyclists were licensed. However, the validity of this assumption is questionable because people who ride motorcycles without valid licenses may be more likely than those who are licensed to be involved in crashes because of lack of skill, knowledge, or a propensity toward risky behavior. Therefore, the crash rate per motorcyclist cannot be accurately determined without a better measure of number of motorcyclists.

An estimate of the number of people who operate motorcycles with and without licenses, as well as an estimate of the amount of motorcycle travel in Michigan would be very useful for assessing changes in motorcycle safety, as well as quantifying the extent of the motorcycle licensing problem. A study to estimate the motorcycling population and amount of motorcycle travel is needed. Such a study could also investigate the reasons why so many motorcyclists are not legally licensed to operate motorcycles, and could identify the characteristics of those likely to be unlicensed.

Although the crash rates per motorcyclists or per VMT could not be determined, it is still possible to work on decreasing the probability of motorcycle crashes by increasing the knowledge and skill of motorcyclists, and by teaching other drivers how to drive near motorcycles.

Programs to increase knowledge and skill among motorcyclists can be linked to licensing. To receive a motorcycle endorsement on a driver's license, a person must

demonstrate knowledge and skills of safe motorcycle operation by passing a written test and driving test. Because they have not passed these tests, the level of knowledge and skills of unlicensed motorcyclists is not known. However, it is reasonable to assume that there is considerable room for improvement. A concerted effort to get all currently unlicensed motorcyclists licensed, and to make sure that new motorcyclists start with a valid license is required. This effort could start with a public information program informing people that it is illegal to operate a motorcycle without the proper licensure, and telling them how they can get licensed. A special enforcement program targeting unlicensed motorcyclists could be combined with the public information program to promote licensing.

Motorcycle training programs, motorcycle dealerships, and insurance companies could be recruited to help address the licensing problem. An emphasis on licensing could be made at the many training programs teaching riding and street skills courses offered at community colleges, by independent programs, and through motorcycle dealerships. Motorcycle dealerships could help by insuring that their customers do not drive off without proof of a valid motorcycle license. Insurance companies could also help by requiring proof that their clients are licensed to operate a motorcycle when selling them motorcycle insurance.

Another issue in licensing is that of the level of skill. Different types of motorcycles require different levels of skill to operate them safely, and some of the larger, heavier models are harder to operate than light, more maneuverable models. Although the crash analysis carried out in the present study did not address this issue, the literature (Shankar, 2001) points out a national trend, especially among the older motorcyclists, toward larger, heavier motorcycles. Anecdotal evidence suggests that some motorcyclists take the driving test on small, maneuverable motorcycles, and once licensed, drive motorcycles that require considerably more skill. One way of ensuring that motorcyclists have the appropriate skills for their motorcycles could be to require changes in the licensing tests. For example, everyone could be required to pass the driving test on the most challenging motorcycle. While this approach is probably somewhat impractical, it may be possible to have several levels of motorcycle endorsement, corresponding to categories of motorcycles. That way, the skills of the motorcyclists would be appropriate for the motorcycle they are operating.

A study comparing the Michigan motorcycle fleet, the type of motorcycles used in driving tests, and the types of motorcycles used by various segments of motorcyclists would be useful in determining if this is really a problem.

Another known but not well-documented issue is that although most motorcyclists wear helmets, some of the helmets are not DOT-approved as required by law, and offer little protection in the event of a crash. Public information programs could help to increase the awareness of the dangers of not using the appropriate gear. A small study could be designed to quantify the extent of the problem, and perhaps use focus groups to help understand this behavior, and develop strategies to counter it.

Because the number of motorcycles is increasing, motorists are encountering more motorcycles on the road. Many motorists do not know the limitations and capabilities of motorcycles, and do not know how to drive safely near them. A public education campaign educating motorists about the differences between the operating characteristics of cars and motorcycles, and the safe ways to drive near motorcycles would help. Similar campaigns have been used to educate motorists how to drive near large trucks. Driving schools and driver education programs in schools could also include a lesson on how to drive near motorcycles. A study of how motorists perceive motorcycles, their attitudes toward them, and how much they know about the operating characteristics of motorcycles would be helpful in developing the educational materials.

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## **APPENDIX A**

### **Motorcycle Licenses by Age and Sex, 1997-2002**

Table A1. Number and Rate of Licensed Motorcycle Drivers by Sex, 1997-2002			
	Male	Female	Total
1997	399,172 (92.1%)	34,233 (7.9%)	433,405 (100%)
1998	403,298 (91.9%)	35,007 (8.0%)	438,805 (100%)
1999	406,509 (91.9%)	35,983 (8.1%)	442,492 (100%)
2000	411,585 (91.7%)	37,108 (8.3%)	448,693 (100%)
2001	418,334 (91.5%)	38,667 (8.5%)	457,001 (100%)
2002	424,924 (91.2%)	40,862 (8.8%)	465,786 (100%)

Table A2. Number of Licensed Motorcycle Drivers by Age Group, 1997-2002						
Male and Female						
	≤18	19-29	30-44	45-64	65+	All Ages
1997	929 (0.2%)	35,741 (8.2%)	204,039 (47.1%)	174,229 (40.2%)	18,467 (4.3%)	433,405 (100%)
1998	813 (0.2%)	34,884 (7.9%)	195,508 (44.6%)	187,637 (42.8%)	19,963 (4.5%)	438,805 (100%)
1999	731 (0.2%)	32,769 (7.4%)	185,270 (41.9%)	202,066 (45.7%)	21,656 (4.9%)	442,492 (100%)
2000	734 (0.2%)	31,800 (7.1%)	176,507 (39.3%)	216,130 (48.2%)	23,522 (5.2%)	448,693 (100%)
2001	761 (0.2%)	31,513 (6.9%)	168,826 (36.9%)	230,362 (50.4%)	25,539 (5.6%)	457,001 (100%)
2002	764 (0.2%)	31,179 (6.7%)	160,813 (34.5%)	244,835 (52.6%)	28,195 (6.1%)	465,786 (100%)

Table A3. Number of Licensed Motorcycle Drivers by Sex and Age Group, 1997-2002						
Male						
	≤18	19-29	30-44	45-64	65+	All Males
1997	867 (0.2%)	33,890 (8.5%)	187,970 (47.1%)	158,916 (39.8%)	17,529 (4.4%)	399,172 (100%)
1998	757 (0.2%)	32,967 (8.2%)	179,986 (44.6%)	171,134 (42.4%)	18,922 (4.7%)	403,766 (100%)
1999	681 (0.2%)	30,866 (7.6%)	170,293 (41.9%)	184,175 (45.3%)	20,494 (5.0%)	406,509 (100%)
2000	695 (0.2%)	29,868 (7.3%)	161,915 (39.3%)	196,892 (47.8%)	22,215 (5.4%)	411,585 (100%)
2001	725 (0.2%)	29,481 (7.0%)	154,382 (36.9%)	209,681 (50.1%)	24,065 (5.8%)	418,334 (100%)
2002	705 (0.2%)	28,898 (6.8%)	146,447 (34.5%)	222,398 (52.3%)	26,476 (6.2%)	424,924 (100%)
Female						
	≤18	19-29	30-44	45-64	65+	All Females
1997	62 (0.2%)	1,851 (5.4%)	16,069 (46.1%)	15,313 (39.8%)	938 (2.7%)	34,233 (100%)
1998	56 (0.2%)	1,917 (5.5%)	15,522 (44.3%)	16,503 (42.4%)	1,041 (3.0%)	35,039 (100%)
1999	50 (0.1%)	1,903 (5.3%)	14,977 (41.6%)	17,891 (45.3%)	1,162 (3.2%)	35,983 (100%)
2000	39 (0.1%)	1,932 (5.2%)	14,592 (39.3%)	19,238 (47.8%)	1,307 (3.5%)	37,108 (100%)
2001	36 (0.1%)	2,032 (5.3%)	14,444 (37.4%)	20,681 (50.1%)	1,474 (3.8%)	38,667 (100%)
2002	59 (0.1%)	2,281 (5.6%)	14,366 (35.2%)	22,437 (52.3%)	1,719 (4.2%)	40,862 (100%)

## **APPENDIX B**

### **Conditions of Single- and Multi-Vehicle Motorcycle Crashes**

Table B1. Single Motorcycle Crashes by Month, 1997-2002												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1997	3 (0.2)	5 (0.4)	29 (2.3)	93 (7.5)	158 (12.7)	249 (20.0)	254 (20.4)	197 (15.9)	134 (10.8)	102 (8.2)	17 (1.4)	2 (0.2)
1998	2 (0.1)	22 (1.5)	35 (2.4)	104 (7.3)	221 (15.4)	212 (14.8)	271 (18.9)	223 (15.6)	187 (13.1)	114 (8.0)	35 (2.4)	6 (0.4)
1999	2 (0.1)	13 (0.9)	39 (2.7)	116 (8.2)	207 (14.5)	223 (15.7)	268 (18.8)	197 (13.8)	195 (13.7)	119 (8.4)	40 (2.8)	5 (0.4)
2000	5 (0.3)	10 (0.7)	86 (5.6)	110 (7.1)	191 (12.4)	281 (18.2)	258 (16.7)	267 (17.3)	157 (10.2)	140 (9.1)	33 (2.1)	5 (0.3)
2001	1 (0.1)	3 (0.2)	48 (2.9)	150 (9.2)	202 (12.3)	267 (16.3)	305 (18.6)	288 (17.6)	191 (11.7)	96 (5.9)	67 (4.1)	20 (1.2)
2002	18 (1.2)	8 (0.5)	30 (2.0)	109 (7.4)	179 (12.1)	268 (18.1)	272 (18.4)	243 (16.4)	227 (15.3)	91 (6.2)	31 (2.1)	4 (0.3)

Table B2. Single Motorcycle Crashes by Day of Week, 1997-2002							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1997	252 (20.3%)	138 (11.1%)	145 (11.7%)	131 (10.5%)	137 (11.0%)	181 (14.6%)	259 (20.8%)
1998	290 (20.3%)	258 (11.0%)	150 (10.5%)	146 (10.2%)	160 (11.2%)	209 (14.65)	319 (22.3%)
1999	292 (20.5%)	143 (10.0%)	152 (10.7%)	154 (10.8%)	141 (9.9%)	212 (14.95)	330 (23.2%)
2000	284 (18.4%)	155 (10.1%)	154 (10.0%)	173 (11.2%)	189 (12.3%)	254 (16.5%)	334 (21.75)
2001	312 (19.1%)	162 (9.9%)	186 (11.4%)	199 (12.2%)	194 (11.8%)	257 (15.7%)	328 (20.0%)
2002	261 (17.6%)	137 (9.3%)	173 (11.7%)	173 (11.7%)	181 (12.2%)	210 (14.2%)	345 (23.3%)

Table B3. Single Motorcycle Crashes by Roadway Condition, 1997-2002							
	Dry	Wet	Icy	Snowy	Muddy	Debris	Other Unknown
1997	1,040 (84.5%)	108 (8.8%)	5 (0.4%)	4 (0.3%)	2 (0.2%)	33 (2.7%)	39 (3.2%)
1998	1,253 (88.3%)	102 (7.2%)	1 (0.1%)	0 (0.0%)	1 (0.1%)	21 (1.5%)	41 (2.9%)
1999	1,283 (91.1%)	59 (4.2%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	30 (2.1%)	36 (2.6%)
2000	1,361 (89.4%)	81 (5.3%)	1 (0.1%)	4 (0.3%)	5 (0.3%)	28 (1.8%)	43 (2.8%)
2001	1,429 (89.3%)	91 (5.7%)	3 (0.2%)	2 (0.1%)	6 (0.4%)	29 (1.8%)	40 (2.5%)
2002	1,290 (89.1%)	71 (4.9%)	1 (0.1%)	1 (0.1%)	2 (0.1%)	35 (2.4%)	48 (3.3%)

TableB4. Single Motorcycle Crashes by Weather, 1997-2002							
	Clear	Cloudy	Fog, Smoke	Rain	Snow, Blowing Snow	Severe Wind	Other
1997	876 (70.8%)	274 (22.2%)	11 (0.9%)	62 (5.0%)	5 (0.4%)	2 (0.2%)	7 (0.6%)
1998	1,037 (72.8%)	316 (22.2%)	13 (0.9%)	52 (3.7%)	0 (0.0%)	0 (0.0%)	6 (0.4%)
1999	1,106 (77.9%)	254 (17.9%)	11 (0.8%)	40 (2.8%)	0 (0.0%)	2 (0.1%)	7 (0.5%)
2000	1,129 (73.6%)	329 (21.4%)	7 (0.5%)	49 (3.2%)	2 (0.1%)	4 (0.3%)	15 (1.0%)
2001	1,193 (74.0%)	350 (21.7%)	8 (0.5%)	50 (3.1%)	3 (0.2%)	1 (0.1%)	8 (0.5%)
2002	1,145 (78.3%)	248 (17.0%)	8 (0.6%)	46 (3.2%)	0 (0.0%)	2 (0.1%)	13 (0.9%)

Table B5. Multi-Vehicle Motorcycle Crashes by Month, 1997-2002												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1997	6 (0.5)	4 (0.3)	30 (2.3)	95 (7.3)	141 (10.9)	276 (21.2)	254 (19.5)	190 (14.6)	178 (13.7)	100 (7.7)	21 (1.6)	5 (0.4)
1998	7 (0.5)	25 (1.6)	49 (3.1)	106 (6.8)	256 (16.4)	220 (14.1)	258 (16.5)	249 (15.9)	218 (13.9)	112 (7.2)	43 (2.8)	22 (1.4)
1999	7 (0.5)	8 (0.5)	39 (2.6)	120 (8.1)	217 (14.5)	253 (17.0)	243 (16.3)	225 (15.1)	195 (13.1)	114 (7.7)	56 (3.8)	13 (0.9)
2000	5 (0.3)	20 (1.2)	88 (5.4)	117 (7.1)	198 (12.1)	265 (16.2)	279 (17.0)	303 (18.5)	179 (10.9)	152 (9.3)	31 (1.9)	4 (0.2)
2001	2 (0.1)	5 (0.3)	42 (2.7)	139 (8.8)	186 (11.8)	284 (18.0)	265 (16.8)	272 (17.2)	195 (12.4)	97 (6.2)	68 (4.3)	23 (1.5)
2002	18 (1.2)	11 (0.7)	27 (1.7)	128 (8.2)	195 (12.4)	246 (15.7)	299 (19.0)	299 (19.0)	216 (13.8)	92 (5.9)	35 (2.2)	5 (0.3)

Table B6. Multi-Vehicle Motorcycle Crashes by Day of Week, 1997-2002							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1997	193 (14.9%)	142 (10.9%)	179 (13.8%)	182 (14.0%)	183 (14.1%)	198 (15.2%)	223 (17.2%)
1998	220 (14.1%)	195 (12.5%)	166 (10.6%)	203 (13.0%)	226 (14.4%)	285 (18.2%)	270 (17.3%)
1999	220 (14.8%)	157 (10.5%)	186 (12.5%)	180 (12.1%)	176 (11.8%)	268 (18.0%)	303 (20.3%)
2000	219 (13.4%)	160 (9.8%)	205 (12.5%)	231 (14.1%)	221 (13.5%)	297 (18.1%)	308 (18.8%)
2001	234 (14.8%)	186 (11.8%)	200 (12.7%)	236 (15.0%)	209 (13.2%)	232 (14.7%)	281 (17.8%)
2002	226 (14.4%)	186 (11.8%)	220 (14.0%)	215 (13.7%)	200 (12.7%)	256 (16.3%)	268 (17.1%)

Table B7. Multi-Vehicle Motorcycle Crashes by Roadway Condition, 1997-2002							
	Dry	Wet	Icy	Snowy	Muddy	Debris	Other Unknown
1997	1,192 (92.8%)	83 (6.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	9 (0.7%)
1998	1,469 (94.7%)	76 (4.9%)	1 (0.1%)	0 (0.0%)	2 (0.1%)	1 (0.1%)	2 (0.1%)
1999	1,420 (95.8%)	48 (3.2%)	0 (0.0%)	2 (0.1%)	0 (0.0%)	3 (0.2%)	9 (0.6%)
2000	1,558 (95.5%)	61 (3.7%)	1 (0.1%)	0 (0.0%)	2 (0.1%)	2 (0.1%)	7 (0.4%)
2001	1,463 (95.6%)	54 (3.5%)	1 (0.1%)	0 (0.0%)	2 (0.1%)	5 (0.3%)	5 (0.3%)
2002	1,492 (96.6%)	45 (2.9%)	2 (0.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (0.3%)

Table B8. Multi-Vehicle Motorcycle Crashes by Weather, 1997-2002							
	Clear	Cloudy	Fog, Smoke	Rain	Snow, Blowing Snow	Severe Wind	Other
1997	972 (75.3%)	250 (19.4%)	4 (0.3%)	61 (4.7%)	1 (0.1%)	0 (0.0%)	3 (0.2%)
1998	1,195 (76.7%)	305 (19.6%)	4 (0.3%)	53 (3.4%)	0 (0.0%)	0 (0.0%)	2 (0.1%)
1999	1,213 (81.9%)	233 (15.7%)	1 (0.1%)	27 (1.8%)	1 (0.1%)	1 (0.1%)	5 (0.3%)
2000	1,233 (75.7%)	350 (21.5%)	2 (0.1%)	38 (2.3%)	1 (0.1%)	0 (0.0%)	4 (0.3%)
2001	1,215 (78.8%)	278 (18.0%)	4 (0.3%)	36 (2.3%)	1 (0.1%)	1 (0.1%)	6 (0.4%)
2002	1,298 (83.8%)	210 (13.6%)	2 (0.1%)	36 (2.3%)	1 (0.1%)	0 (0.0%)	2 (0.1%)